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ACTION DESCRIPTION MEMORANDUM

NIAGARA FALLS STORAGE SITE

PROPOSED INTERIM REMEDIAL ACTIONS

FOR FY 1983

(NONACCELERATED PROGRAM)

Prepared by

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CONTENTS

SUBJECT: Proposed FY 1983 Interim Remedial Actions at the Niagara Falls Storage Site*

SUMMARY OF PROPOSED ACTION AND RELATED ACTIVITIES

As part of its Surplus Facilities Management Program (SFMP) and Formerly Utilized Sites Remedial Action Program (FUSRAP), the U.S. Department of Energy (DOE), Oak Ridge Operations Office, proposes to carry out an interim remedial action project in FY 1983 at the Department's Niagara Falls Storage Site (NFSS) in Niagara County, Lewiston Township, New York (Figure 1). The project will involve reconsolidation, stabilization, and other control measures for various radioactive residues and contaminated materials located on the site and in drainage ditches. Specific project actions include:*

- Clearing and grubbing of trees and brush from portions of the site, from the west and central drainage ditches (onsite and offsite) and along the site perimeter fence.
- Excavation from the cleared areas of sediments and soil materials that have a radium-226 concentration in excess of 15 pCi/g above background. The excavated materials will be placed within an existing diked area (R-10 pile) on the site. Uncontaminated fill materials will be placed in the excavated areas to reestablish proper drainage grade.
- Transfer of uranium ore-processing residues (Middlesex sands) stored in Building 410 to either the R-10 pile diked area or the basement of Building 410.
- Partial dewatering and construction of a multilayer cover system over the residues currently stored in Building 411.
- Demolition of Building 410.

Details of these activities are given in the section "Proposed Action and Alternatives."

This work will be a continuation of interim remedial work begun in 1982 as part of DOE's ongoing maintenance and caretaker operations at NFSS. The 1982 remedial action consisted of: (1) reconsolidation and stabilization of the R-10 pile of radioactive residues, (2) construction of a dike and subsurface, clay cutoff wall (trench) around the R-10 pile, (3) removal of wooden roofs and construction of a multilayer cover system over radioactive residues

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result, most of the residues are now under water, and radon levels in the air above the residues have been reduced from about 24 WL (working level) to 1 WL (Bechtel Natl. Inc. 1983). Prior to the 1982 work, about 3,000-3,500 m^3 (790,000-920,000 gal) of water covered portions of the residues. Efforts were taken in 1982 to determine the concentrations of radionuclides and heavy metals in this water, but the results have not yet been published. The source of the water has been largely attributed to precipitation that enters the building through the leaky roof, although connections to other buildings (which were disconnected in 1980 and 1982) may be an additional source of water (Ausmus et al. 1980).

Building 410 currently contains about 175 m^3 (230 yd^3) of U.S.-owned residues (Middlesex sands) (Ausmus et al. 1980; Anderson et al. 1981). Radioactive contamination is present throughout the facility as a result of prior storage activities, leaching, and water transport of the residues. There is contaminated water in the canals in the bottom floor of Building 410. This water may have originated from precipitation and possibly from shallow saturated zones in the surrounding soils (Ausmus et al. 1980). It then became contaminated upon contact with the residues and contaminated surfaces in the building. The level of uranium in the residues is less than 100 ppm, and radium is less than 10 pCi/g (Anderson et al. 1981). Radon levels in the building range from 3 to 26 pCi/L (Ausmus et al. 1980).

The proposed clearing and excavation areas (Figures 3 and 4) are contaminated as a result of past storage activities as well as wind and water erosion of stored materials, particularly erosion of residues from the R-10 pile located north of Building 411. (Remedial action was taken in 1982 to stabilize and construct a dike around the R-10 pile.) Other contaminated areas on the site--excluding contaminated buildings, residues, and ditches--are shown in Figure 5. Radium-226 concentrations in these contaminated areas (Table 1) are above the criterion that is being used for interim actions at NFSS (i.e., 15 pCi/g above background). In the central ditch sediments, radium-226 concentrations are as high as 1,900 pCi/g in a small section onsite (Table 1); concentrations offsite are at least a factor of 10 lower. Cesium-137 is the primary contaminant in the northwest area (Area 3, Figure 5), with soil concentrations as high as 59,000 pCi/g in a small 1-m^2 (11-ft^2) area to a depth of 1.2 m (4 ft) (Ausmus et al. 1980; Anderson et al. 1981). This contamination results from previous storage of reactor materials in this area.

More detailed information on the extent of the radioactive contamination on and near the site as well as possible alternatives for disposition of the Afrimet residues and the entire NFSS can be found in: U.S. Atomic Energy Commission (1974); Cavendish et al. (1978); Ausmus et al. (1980); Acres American Incorporated (1981a, 1981b, 1981c); Anderson et al. (1981); Battelle Columbus Laboratories (1980); and Bechtel National, Inc. (1982a, 1982b, 1982c, 1982d, 1982e, 1982f).

SETTING

The Niagara Falls Storage Site is located in Niagara County in Western New York (Figure 1), within the town (township) of Lewiston and adjacent to the town (township) of Porter. It is about 30 km (19 mi) north of Buffalo, New York; 10 km (6 mi) north of the city of Niagara Falls; 6.5 km (4 mi) south of Lake Ontario; and 5 km (3 mi) east of the Province of Ontario, Canada.

There are several buildings and private roads on the fenced-in site (Figure 3). The site is zoned industrial and is currently used only for storage of radioactive residues and soils. Most of the site is covered with second-growth forest, shrubs (brush), grasses, and marsh vegetation. Surface water flows into the west and central ditches and subsequently into Fourmile Creek and Lake Ontario (Figure 6). The channeled ditches are overgrown with cattails. Water flow, when it occurs, is generally slow (Ausmus et al. 1980), except during spring melt when the flow may be rapid; much of the time there is essentially no flow at all. The 100-year floodplain is contained within the drainage ditches (U.S. Dep. Housing Urban Dev. 1980).

Land uses immediately adjacent to the site are varied. A hazardous-waste-disposal facility operated by SCA Chemical Waste Services is located north and east of the site. A sanitary landfill is being constructed to the east by Modern Disposal, Inc. South of the site is federal government property controlled by the General Services Administration and used for training construction equipment operators. There is also a sanitary landfill south of the site, which is owned by the town of Lewiston. West of the facility is a Niagara Mohawk Power Corporation transmission line corridor (Acres American Inc. 1981a). All these properties are located on land that was once part of the original MED site (Figure 2). There are eight property owners (including the U.S. Government) located along offsite portions of the west and central drainage ditches north of the site (Acres American, Inc. 1981a).

Land uses within the towns (townships) of Lewiston and Porter are predominantly rural and include row-crop agriculture, orchards, recreation areas, old abandoned fields, and second-growth forests (Table 2). These areas are projected to remain rural through the year 2000. A recreational area, Fourmile Creek State Park, is located at the confluence of Fourmile Creek and Lake Ontario, about 3 km (2 mi) downstream from the central ditch (Figure 6).

The nearest permanent residence is 1.1 km (0.7 mi) southwest of the R-10 pile, and there is a trailer park 2.6 km (1.6 mi) northwest on Balmer Road (Figure 7). Workers at SCA Chemical Waste Services work outdoors 1.2 km (0.75 mi) north of the R-10 pile. During the summer, there are campers at the KOA campground 0.7 km (0.4 mi) southwest of the R-10 pile on Pletcher Road (Figure 7). Hunters occasionally use the area west of the Niagara Mohawk corridor.

The population of Niagara County, which has declined since 1970, was 227,101 in 1980 (Table 3). Population growth to the year 2000 is projected to be minimal (Table 3). Local town (township) and village population statistics are presented in Table 3. The nearest major population centers are the city of Niagara Falls (71,384) and the Buffalo metropolitan area (1.5 million). As of May 1982, the county had a civilian work force of 104,169, with an unemployment rate of 13.6%.

Major highway transportation routes in the area are State Route 93 to the north, U.S. Route 104 to the south, and the Robert Moses Parkway to the west (Figure 1). Local roads near the site and central drainage ditch include Lutts, Cain, Balmer, Pletcher, and Porter Center roads (Figure 7). No traffic counts on local roads are currently available.

Niagara County has a humid, continental climate that is moderated by the lake effects of Lakes Erie and Ontario. Average annual precipitation is 83 cm (33 in.), which is fairly evenly distributed throughout the year. Approximately 140 cm (56 in.) of snow falls, primarily between November and March (Acres American Inc. 1981a). The wind is predominantly from the southwest.

The NFSS is located on the southern shore of Lake Ontario, 3.2 km (2 mi) north of the Niagara Escarpment (Figure 1), on the relatively flat terrain of the Erie-Ontario Lowlands Physiographic Province. Elevations at the site range between 93 and 98 m (310 and 320 ft) MSL; the lower elevations correspond to the man-made drainage ditches. Creeks and drainage ditches on the site and surrounding areas are shown in Figure 6. About one-third of the site has soils that remain saturated throughout the year and are covered by marshy vegetation.

Geologically, the region is characterized by approximately 15 m (50 ft) of overburden that is underlain by a 274-m (900-ft) sequence of Ordovician-age shales and siltstones of the Queenston Formation. The overburden material is composed of glacial and recent alluvial deposits and includes dense tills, glaciolacustrian clays, and numerous lenses of glaciofluvial sands and gravels (Acres American Inc. 1981a, 1981b).

At NFSS, groundwater is present in both the glacial/alluvial deposits and bedrock and generally flows towards the northwest. There are essentially three aquifers underlying NFSS: (1) an unconfined, perched soil aquifer in a series of possibly discontinuous sandy silt or silty sand lenses 3 to 6 m (10 to 20 ft) below the ground surface, (2) a continuous, confined soil aquifer within the brown silty sand unit approximately 9 to 12 m (30 to 40 ft) below ground surface, which is contiguous with (3) a confined bedrock aquifer within the weathered upper meter of the Queenston Formation (Acres American Inc. 1981b). The groundwaters of all aquifers underlying NFSS have high concentrations of sulfate and calcium and are of low quality for drinking water (Acres American Inc. 1981a). Although private wells near the site have been monitored for radionuclide concentrations in groundwater, no ranges or seasonal variations have been published to date, and background concentrations for the site and region have not yet been established.

The radiological characteristics of the various residues, contaminated areas, and ditch sediments were described in the preceeding section. The residues and ditch sediments also contain metals and rare earths (Table 4). Concentrations at some sampling sites in the central drainage ditch are as high as those in the R-10 pile, probably due to past erosion of materials from the pile into the ditch. North of NFSS, the central ditch may also be contaminated with metals and organic compounds from SCA Chemical Waste Services operations (hazardous waste management). Until recently, SCA discharged to the central ditch (discharges are now routed through a pipe to the Niagara River). As specified in the old SCA State Pollution Discharge Elimination System (SPDES) permit (N.Y. Dep. Environ. Conserv. 1979), the discharges from SCA were limited to batch discharges at times when water was flowing in the ditch (a few weeks in spring and fall) such that the ditch flow diluted the discharge by a factor of 20 (Ludlam 1982). The discharges were monitored for pH, specific conductivity, and some organic chemicals. Heavy metals were removed prior to discharge. In addition to this discharge, there may be some contamination resulting from runoff into the central ditch from unsecured areas on SCA property during rainy periods (Ludlam 1982). No information is available on concentrations of metals or organic chemicals in ditch sediments downstream of SCA property. Samples of ditch sediments downstream of SCA are being analyzed for EPA priority pollutants.

Various state and local governing bodies may have jurisdiction over or concern about the proposed remedial action at NFSS (Table 5). Local residents and interest groups have also shown interest and concern about the site. Newspaper articles have appeared, and private citizens have written letters to DOE and the U.S. Environmental Protection Agency (EPA). A Citizen's Oversight Committee was formed by U.S. Representative John LaFalce in response to public questions raised concerning the potential health hazards at the site (LaFalce 1980). Representative LaFalce has indicated that the purpose of this committee is to advise him regarding NFSS and to work with DOE to ensure that DOE's proposals are sound and acceptable to the committee. In a recent report to New York Assembly Speaker, Stanley Fink, regarding federal involvement in several hazardous-waste sites in the Niagara Falls area (Zweig and Boyd 1981), NFSS was mentioned as posing a hazard to public health and safety. There has been debate on whether the alleged hazards actually exist. Since October 1982, there have also been numerous newspaper articles about potential DOE long-term actions at the site and about discharges of contaminated water. Awareness and concern about radioactive and other hazardous wastes have been heightened by publicity about the nearby Love Canal toxic waste problem, the nearby West Valley high-level-radioactive waste project, and the Three Mile Island nuclear power plant accident (Zweig and Boyd 1981; U.S. Dep. Energy 1982c).

PROPOSED ACTION AND ALTERNATIVES

The Department of Energy proposes to take interim remedial actions to reconsolidate, stabilize, and control radioactive materials located on and near NFSS as part of its ongoing maintenance and caretaker operations. Details of the proposed FY 1983 actions are as follows.*

Several areas onsite (Figure 3) will be cleared of trees, brush, logs, and other dead wood. Also to be cleared are (a) the offsite west drainage ditch (Figure 6), (b) about 3.2 km (2 mi) of the central drainage ditch immediately north of the site (Figure 6), (c) a swath about 6-m (20-ft) wide along one side of the ditches (for a haul road), and (d) a swath about 3-m (15-ft) wide along the perimeter fence. The larger stumps and roots will be grubbed out. A total of about 27 ha (66 acres) will be cleared, 15 ha (36 acres) onsite and 12 ha (30 acres) offsite. The cleared and grubbed material will be temporarily stored at two onsite storage areas (Figure 3).

Contaminated sediments and soil materials will then be excavated and placed in the R-10 pile diked area. For this proposed action, contaminated materials will be defined as those materials having a concentration of

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radium-226 greater than 15 pCi/g above natural soil background or a concentration of cesium-137 greater than 80 pCi/g. Based on previous radiological surveys and engineering estimates (Ausmus et al. 1980; Anderson et al. 1981; Acres American Inc. 1981a), it is estimated that about 23,000 m^3 (30,000 yd^3) of contaminated sediments will have to be removed from the offsite ditches (Figure 6) and about 11,000 m^3 (14,000 yd^3) will have to be removed from the various locations onsite (including onsite ditches, Figure 4).* It is expected that the depth of excavation will vary from 0.2 to 1.2 m (0.5 to 4 ft) in the ditches and from 0.2 to 0.6 m (0.5 to 2 ft) elsewhere.* The amount that may actually have to be removed from the ditches may be half or twice as much, depending on the actual lateral and vertical extent of contamination (Acres American Inc. 1981a). Additional radiological survey work is being performed to more precisely define the extent of needed excavation.

Temporary haul roads will be constructed alongside the ditches. As soon as these roads can support construction traffic in early summer, excavation of ditch materials can begin, starting at the upstream end. The subcontractor will be allowed a choice of methods, as long as the spread of contaminated soils/sediments and water is controlled. An example of one excavation method that may be used is a check dam/dewatering system (Figure 8). A check dam made out of clean (uncontaminated) fill material would be constructed across the ditch upstream of the section to be excavated. Two downstream check dams would be constructed by pushing up contaminated ditch materials. Any water in the upstream section would be pumped to the downstream section in order to dewater the area to be excavated. This water would either be released downstream, if radioactive contamination limits were not exceeded, or pumped via temporary pipes to the onsite sedimentation pond/water treatment system (see later discussion). After a section was excavated, the upstream check dam of clean fill would be used as partial backfill to restore the ditch grade. Additional clean fill would be brought in for completion of the desired grade and for construction of a new, clean check dam at the downstream end of the excavated section. A new water-holding/sedimentation section would be created farther downstream. About three days would be required to complete excavation and backfill for each section. In the farthest downstream sections of the central drainage ditch, where water flow is greater, this same basic system could still be used, but with the addition of a lengthwise dike down the center of the ditch to channel water to one side while dewatering and excavating the other side.

Backfill material for the ditches will probably be the same kind of local clay that is being used in the construction of the R-10 dike during 1982. This clay, which is similar to the clay soils that underly the ditches, would be compacted to 90% of theoretical maximum density. Some of the spoil piles that are alongside the ditches from the original ditch construction may be

*The estimates for depths and volumes of excavation were originally based on a proposed definition of contaminated materials as those materials having a concentration of radium-226 greater than 5 pCi/g above soil background. The action criterion for this proposed action has since been revised to 15 pCi/g for radium-226. Volumes and depths of excavation will therefore probably be less, but revised estimates are not yet available. The analysis in the next section of the Action Description Memorandum is based on the original estimates and thus represents a conservatively high estimate of potential impacts.

used as backfill. Backfill needed for both onsite and offsite work will probably be equivalent to the amount of excavation, or a total of 34,000 m^3 (44,000 yd^3) (ranging from 17,000-68,000 m^3). There are several local sources of backfill materials, including excess materials that were excavated for the hydroelectric and pump storage projects in the Niagara Falls area.

Immediately after a section of ditch or onsite area has been excavated and backfilled, the area will be scarified, seeded, and mulched (probably using a hydroseeder), and covered with jute netting, as necessary, to stabilize the surface and prevent erosion. Straw bales, diversion swales, and any other temporary runoff and erosion control devices will be removed.

All excavated contaminated materials will be placed within the R-10 diked area (Figure 4). After the materials are sufficiently dry, they will be "conditioned" by discing and compacting. A synthetic reinforced rubber membrane (EPDM) will be placed over the materials. If the materials are too wet at the end of the construction season, they will be temporarily covered with EPDM until next year when they can be properly conditioned.

Several of the ditch culverts under roads are currently undersized relative to potential storm runoff. Therefore, the old culverts will be removed in order to excavate contaminated materials and will be replaced with larger culverts. At the Balmer Road crossing, the road will be kept open to traffic by either constructing a temporary bypass on one side, using sheet piling and excavating one-half at a time, or constructing a temporary bridge to one side. At the Lutts Road crossing, the road may have to be temporarily closed to traffic because the entire crossing area may be contaminated from previous reworking of the culverts and roadbed with potentially contaminated ditch sediments.

About 30 m (100 ft) of two abandoned water pipelines (19-inch line to the former firewater reservoir/pond west of the site and 42-inch water main to the town of Lewiston) will be removed between the southwest building area and Lutts Road to preclude any future migration of contaminated materials via these pathways.

Truck traffic (for transport of contaminated and backfill materials) will be routed to avoid congestion and to minimize the spread of contamination. The temporary haul road alongside the ditches will be used to transport contaminated materials to the R-10 pile diked area, whereas public and private roads will be used for movement of backfill material. Some temporary access roads may have to be built to the central ditch, depending on arrangements with property owners. Peak construction traffic on public roads (Figure 7) is not expected to exceed 18 trucks per hour during the main excavation/backfill period, which will last about three months. Peak construction traffic crossing Balmer Road near the central ditch and Lutts Road is expected to be 24 trucks per hour. Routing of construction traffic will depend on subcontract awards (e.g., location of backfill materials), but Pletcher, Balmer, and Lutts roads are expected to bear most of the construction traffic.

Vehicles leaving the contamination control areas will be washed down, as necessary, at the onsite decontamination pad (constructed in 1982, Figure 3). About six vehicles per hour can be accommodated. Water for washing the vehicles and for wetting down roads and work areas will be taken from the onsite water treatment ponds and, if necessary, from existing onsite town hydrants.

The 175 m^3 (230 yd^3) of Middlesex sands currently located in Building 410 (Ausmus et al. 1980) will be moved to the north end of the R-10 pile diked area or placed in the basement of Building 410 (Figure 3) and covered with contaminated soils excavated from other areas. The method of movement has not yet been determined, but hydraulic mining (slurry) may be used.

The residues in Building 411 will then be dewatered to provide a firm working surface and to reduce possible migration of nuclides from the residues into the groundwater. The water resulting from the dewatering process will be routed through the sedimentation pond/treatment system (see below) before release. A multilayer cover system (possibly consisting of EPDM-reinforced synthetic rubber membrane and a layer of clay) will be placed over the residues to reduce the amount of radioactive radon-222 gas escaping from the residues.

The canals in Building 410 will also be dewatered, and the abovegrade portions of the building will be demolished. The belowgrade structure will be used for storage of contaminated rubble and possibly the Middlesex sands. The portion of Building 410 that will have to be disposed as contaminated rubble will have to be determined in the field. Uncontaminated rubble will either be stored onsite or may be converted to riprap for stabilizing the sides of the R-10 dike.

The onsite sedimentation pond/water treatment system (constructed in 1982, Figure 3) will be used to treat water resulting from: (1) leachate or runoff from the excavated materials placed on top of the R-10 pile (contained within the dike), (2) washing of equipment at the vehicle decontamination facility, (3) ditch dewatering, if necessary, and (4) dewatering of residues in Building 411 and canals in Building 410. The two sedimentation ponds can be operated independently and have holding capacities of 1,000 m^3 (250,000 gal) and 1,500 m^3 (400,000 gal), or a total of 2,500 m^3 (650,000 gal). They are designed to hold the runoff from a 10-year rainfall event, and backup capacity is provided within the R-10 dike area (until the area is filled up with contaminated soils at the end of interim actions in future years). If sedimentation alone is not sufficient treatment to meet DOE operating limits for discharge to the central drainage ditch (30 pCi/L for radium-226), a portable water treatment unit--which includes a charcoal filter, a radium-specific DOW Chemical Company medium (proprietary), and a cation resin--will be used to reduce concentrations of radium-226 to allowable limits. This unit can treat an average of 0.076 m^3/min (20 gal/min) in batches from the two small holding (clean water) ponds (maximum design rate is 0.2 m^3/min [54 gal/min]). All discharges will be monitored to ensure compliance with the SPDES permit. During excavation of the central drainage ditch, water can either be discharged to the ditch below the excavation area via temporary pipes, or discharged above the excavation area and pumped around the excavation, if necessary.

It is anticipated that the proposed activities will be completed during the 1983 summer construction season (May through October). There will be about the same number of workers as during the 1982 season, i.e., a total of 70, including 25 management and monitoring personnel brought in from outside the area. It is expected that construction workers will be affiliated with local Niagara County unions, as was the case for the 1982 work.

A summary of mitigative measures and monitoring that will be part of this proposed action is given in Table 6.

There are two basic alternatives to this proposed action: (1) defer action until the permanent disposition of NFSS can be determined, and (2) remove the excavated contaminated materials to some other site for permanent disposal. Because the permanent disposition of NFSS is unlikely to be determined for about two years, DOE considers it prudent to continue the interim program of returning contaminated materials to the site and bringing the site under control to meet DOE operating regulations. The second alternative cannot be implemented because no offsite permanent disposal sites are available for disposal of these wastes.

POTENTIAL ISSUES AND ANALYSIS

Using the information given in the previous sections, as well as the methods of analysis discussed in a report by Argonne National Laboratory (1982), the following potential issues were identified and assessed.*

Radiological

A major potential issue is the radiological impacts associated with the proposed action. The predominant pathway by which the radionuclides could reach nearby workers and members of the general public during the proposed action is inhalation of contaminated dust particles and radioactive decay products such as those from decay of radon gas (one of the radionuclides in the decay chain of the uranium-238 found at NFSS). Other pathways (such as external dose from submersion in a cloud of dust, external dose from radioactive particles deposited on the ground, or internal dose from ingesting contaminated food or water) are expected to be relatively insignificant (Argonne Natl. Lab. 1982). The bases for the analysis of potential doses to nearby members of the general public during the six months of the proposed action are as follows:

- Based on gamma-level readings, an average concentration of 100 pCi/g for each of the uranium-238 decay series nulides present in the contaminated materials that will be moved during the proposed action was considered to be appropriate for analysis of radiological impacts. This is a realistic approximation for radium-226 concentrations, but it is conservatively high for all other nuclides (which leads to a probable overestimation of impacts).

- It is expected that the major portion of radioactive dust releases will be at the R-10 pile where contaminated materials will be unloaded, dried, disced, mixed, and compacted. Dust emissions from similar general construction activities have been estimated to be about 2700 kg/ha/mo, and it has been found that dust controls, such as will be instituted during the proposed action (Table 6), reduce emissions by about 50% (U.S. Environ. Prot. Agency 1977). Therefore, the analysis was based on an emission rate of about 1350 kg/ha/mo for an area equivalent to one-half of the R-10 pile (1.1 ha [4.8 acres]) over the six months of the proposed action.

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*When preliminary engineering is completed on the anticipated additional FY 1983 actions, a supplemental ADM will be prepared that will address the additional actions and related environmental issues.

- Each nearby member of the public was conservatively assumed to be present during the hours the action will take place.
- Buffalo meteorological data were used since onsite data have not yet been analyzed.
- The contribution from the cesium-137 present in the northwest corner of the site (see Proposed Action) was not calculated because the small amount of cesium would contribute a very small fraction to the total dose.
- The methods of analysis are detailed in the Argonne National Laboratory (1982) report.

Assuming that the mitigating measures discussed in Table 6 are employed, potential doses to members of the public near the proposed action are expected to be extremely low (Table 7). The predicted whole-body doses are similar to doses received while spending a few minutes on a jet plane at high altitudes or spending the same amount of time as the remedial action (six months) at an altitude that is a few feet higher (Table 8). Specific organ doses (e.g., bone and lung) are much less than doses received from natural sources (Table 8).

Doses to workers will be controlled and limited to less than those specified by federal regulations for occupational doses (e.g., whole-body doses of 3000 mrem/quarter or 5000 mrem/year). Based on experience during the 1982 remedial action at NFSS, worker doses are expected to be well below limits. Workers are also being trained regarding radiation risks and proper health physics procedures (Table 6).

Another radiological issue may be whether the decontamination criterion for the offsite portion of the drainage ditches (15 pCi/g above background for radium-226) will be considered sufficient to allow unrestricted use of the offsite areas. The DOE believes that this decontamination criterion is conservatively low compared to any applicable criterion or standard for release of an area for unrestricted use that may be promulgated in the future.

The adequacy of the sedimentation pond/water treatment system with respect to discharge of radioactively contaminated water may also be an issue. Sedimentation alone may be sufficient to allow discharge of runoff water. However, the waters in the buildings, particularly Building 411, have been in contact with the stored residues and may have higher concentrations of dissolved substances as well as higher concentrations of fine particles that do not readily settle out. Therefore, these waters will be monitored prior to discharge to the sedimentation ponds and, if necessary, will be treated in batches separate from the storm runoff water. The treatment system, consisting of a radium-specific DOW medium, charcoal filter, and cation resin will be tested in 1982 so that its effectiveness in removing contaminants will be known before the dewatering of Building 411 begins in FY 1983. No water will be released unless concentrations of radioactive substances are at or below DOE operating limits (see later discussion of nonradiological substances in the discharge).

The sufficiency of the water discharge criteria for radioactive contaminants may be an issue. Although the discharge will be at or below DOE operating limits (e.g., 30 pCi/L for radium-226), a discharge at or only slightly lower than the established limits may not be considered to be "as low as reasonably achievable" (ALARA). However, as mentioned previously, the Department tested a new proprietary DOW medium during 1982. This system was purchased and will be employed during the proposed FY 1983 action. In practice, the contaminants in the discharge may actually be present at levels well below the DOE operating limits, in keeping with ALARA.

Physical and Biological

The temporary increase in erosion and sedimentation during the proposed action may be another issue. However, mitigating measures--such as the use of straw bales and diversion swales, scarification and jute netting, prompt seeding and mulching, and diversion of runoff through a sedimentation pond--should help minimize the potential for erosion and sedimentation.

The adequacy of the sedimentation/holding ponds to retain runoff water may be an issue. The system has been designed to accommodate a 10-year storm event, but a sequence of rainfalls of lesser magnitude over a short period of time could stress the system. However, the R-10 diked area would provide additional backup retention if necessary.

The adequacy of the sedimentation/treatment system with respect to discharge of nonradiological chemical pollutants may also be an issue. There will be two primary sources of chemically contaminated water: (1) the Building 411 water and (2) the leachate and runoff from the central drainage ditch sediments. The Building 411 water may be of concern with respect to elements such as arsenic, chromium, cobalt, copper, lead, nickel, and selenium (Table 4). These elements will be both dissolved in the water and associated with fine clay particles that will not readily settle out. Therefore, this water will be tested for these elements prior to discharge to the central drainage ditch. An SPDES permit is needed with respect to the nonradiological nature of the discharge. If contaminant concentrations exceed applicable state discharge limits, the water will be treated, as necessary, to reduce contaminant concentrations to acceptable levels. Available treatments include filters and ion-exchange columns. It is expected that the SPDES permit will be granted prior to the planned FY 1983 actions.

The central ditch sediments may be of concern both with respect to metals such as cobalt, copper, and nickel (Table 4) and, in the vicinity of SCA Chemical Waste Services, with respect to both hazardous organic compounds and metals. The proposed action could result in release of these chemicals further downstream at a temporarily accelerated rate and could also lead to release in the discharge from the sedimentation/treatment system to the central ditch. These chemicals could be dissolved in leachate waters and/or suspended on fine particles. Because the significance of this potential issue will depend in part on the amounts of chemicals in the sediments, the sediments in the vicinity of SCA will be sampled and tested for metals and organic compounds based on the kinds of wastes SCA has handled in the past. Although Ludlam (1982) maintains that discharge and cleanup procedures at SCA were sufficiently rigorous that essentially no organics or metals were discharged, leached or washed into the central ditch, it is considered prudent to analyze the ditch sediments. After such analysis, the consequences of excavating and storing the ditch material will be reevaluated. It is possible that the currently proposed action and mitigative measures (e.g., excavating the ditch in sections, controlling seepage and runoff, using seamless or lined trucks, covering the ditch sediments in the R-10 pile diked area as soon as possible after drying and compacting) will be sufficient to preclude significant adverse impacts. If necessary, the excavation and storage method and/or water treatment and monitoring system will be modified to preclude the discharge of unacceptable concentrations of metals or organic compounds.

Two other potential issues with respect to organic contaminants in the ditch sediments have been raised: (1) the presence of organic substances may increase the rate of migration of radionuclides from the R-10 area to surface waters and groundwaters, and (2) the organic substances may degrade the rubber membrane (EPDM) cover (Ausmus 1981). Based on currently available information and considering that the organic ditch material will be mixed with clay ditch material (diluted) and dried (less organics in free liquid form), there will probably not be enough organic contaminants to be of concern. If significant amounts of organic contaminants are found in the ditch sediments, these issues will be reevaluated before the proposed action is taken, and the action will be modified as appropriate.

The decay of organic matter in the ditch sediments, leading to a buildup of gases under the EPDM cover, may also be a potential issue. However, a sample of ditch material was excavated in early 1982 and it was found that although the top 0.15 m (0.5 ft) is "black, smelly, slimy" organic material, the next 0.6-1.2 m (2-4 ft--depth of expected excavation) is a very tight clay (Levesque 1982). After drying out, discing, and compacting the ditch sediment material on the R-10 pile, plus covering the pile with EPDM/clay/soil, the decay of the organic matter should be sufficiently slow so that gases will not build up appreciably under the permanent cover system. Care will be taken to dry and thoroughly mix the ditch materials. The surface of the pile will be monitored for bulges, cracks, or other signs of any buildup of decomposition gases (Table 6).

In addition to the previously mentioned water quality issues, a potential issue associated with the dewatering of Building 411 is the continued migration of contaminants from the building. The proposed remedial actions should substantially decrease the movement of water into and out of the building. However, there may be some remaining connections to the groundwater through the building foundation. One or more of the pipes inserted into the residues for dewatering will be used to monitor any water level changes in the future. The potential issue of any remaining migration will be addressed when decisions are made regarding additional remedial actions.

The proposed dewatering and construction of a multilayer cover system over the Building 411 residues also raises the issue that this action may be a premature commitment of resources if it is found that the residues must be removed by a slurry method for permanent disposal elsewhere on NFSS or for preparation of the residues for disposal in a different form. However, because the ultimate disposition of the site--and specifically the Building 411 residues--is unlikely to be resolved in the near future, DOE considers the partial dewatering and construction of a cover system to be prudent caretaker actions.

The potential for continued migration of contaminants to groundwater from the materials stored within the R-10 pile dike may also be an issue. However, the combination of the subsurface clay trench, the dike, and the multi-layer cover system, will substantially reduce the rate of contaminant migration from the R-10 area. The potential issue of any remaining migration will be addressed when a decision is made on the permanent disposition of NFSS

Socioeconomic

The major potential socioeconomic issue associated with the proposed action is public apprehension that this interim action may lead to establishing NFSS as a permanent radioactive waste disposal site. However, none of the proposed actions are physically irreversible. Lacking any decision regarding permanent disposition of the site and given that removal of wastes from the site is only one of several alternatives, DOE believes that it is prudent to take the proposed interim action as part of its ongoing caretaker and maintenance responsibilities at the site. The mitigating measures presented in Table 6 -- such as informing the public about the proposed interim action and assuring them that they will be involved in any decision-making concerning the long-term, permanent disposition of the site -- should reduce apprehensions.

Another potential socioeconomic issue is the increased traffic, particularly at the Balmer Road crossing, and the potential for increased risk of vehicle accidents. Although no traffic count data are available, it is known that SCA traffic uses Balmer Road and that the road is a primary east-west route through the area (second to NY-93 and U.S. 104). There are no other major industrial, commercial, recreational, or residential areas along the roads likely to bear most of the construction traffic associated with the proposed action. Having a flagman at the Balmer Road crossing (Table 6) should help mitigate the increased accident potential. Furthermore, residential areas will be avoided when transporting backfill materials to the site and ditches.

The need to obtain right-of-way for equipment across private property may be an issue. However, the Federal Government still holds easement rights for maintenance of the central ditch (Acres American, Inc., 1981a). Informing landowners of intended actions and courteous respect for their property rights and interests can help to mitigate adverse public reaction to the proposed remedial actions.

Determination of the need to obtain several permits may be an issue. The Department has already applied to the New York State Department of

Environmental Conservation (DEC) for an SPDES permit for the non-radiological aspects of the discharge from the sedimentation/treatment system. The U. S. Army Corps of Engineers and the DEC will also be contacted to determine if Section 404 and 402 permits concerning dredge and fill operations in the central drainage ditch and pollutant discharges are needed. The DEC will be contacted to determine if a permit is needed for hauling contaminated sediments back to the site under Article 27, Title 3, of the New York Conservation Law (Part 364, collection and transportation of industrial-commercial and certain other wastes). The need for a permit to burn contaminated materials, and possibly emit radioactive substances to the air, will also be ascertained.

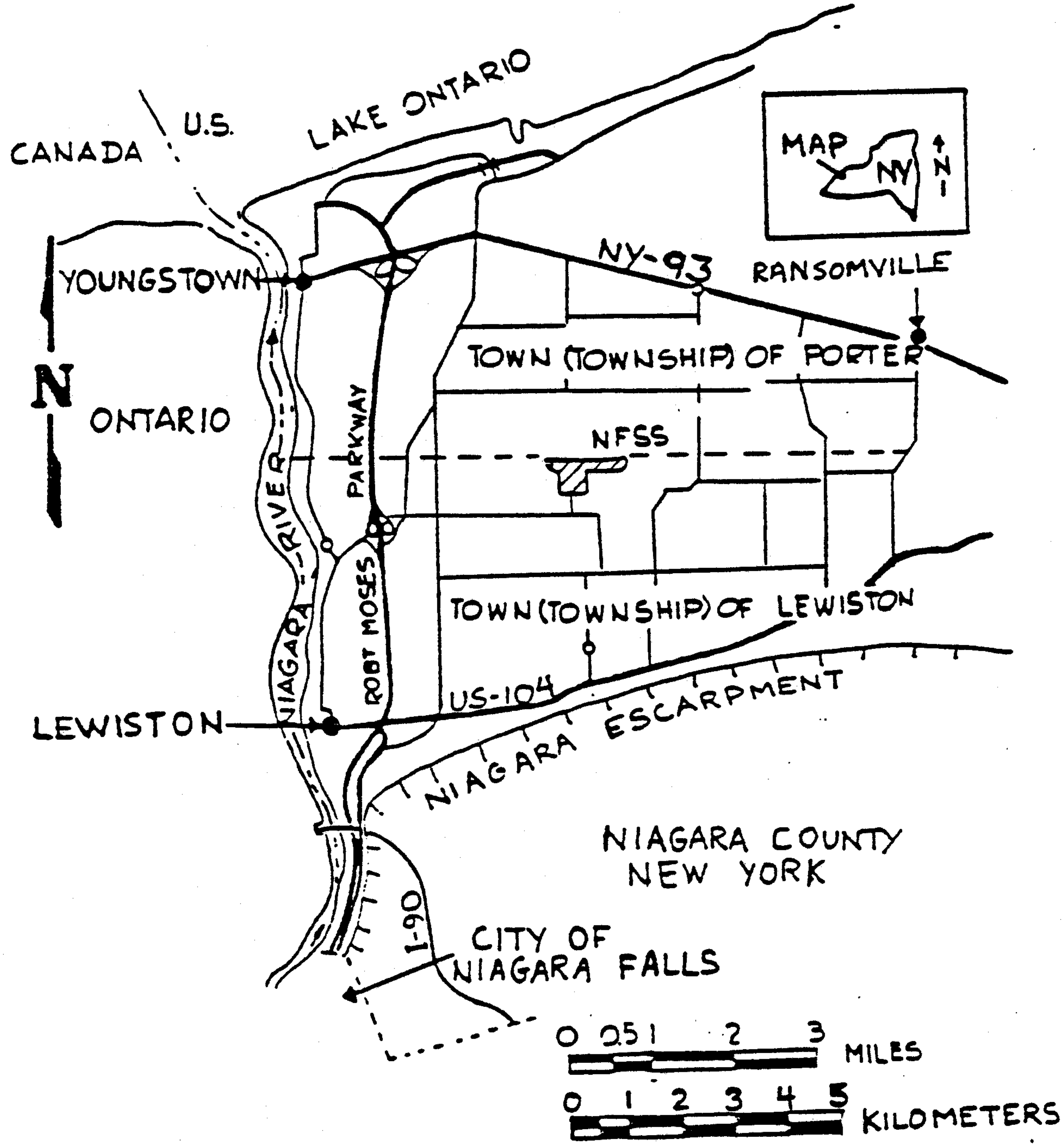

Figure 1. Niagara Falls Storage Site Location Map.

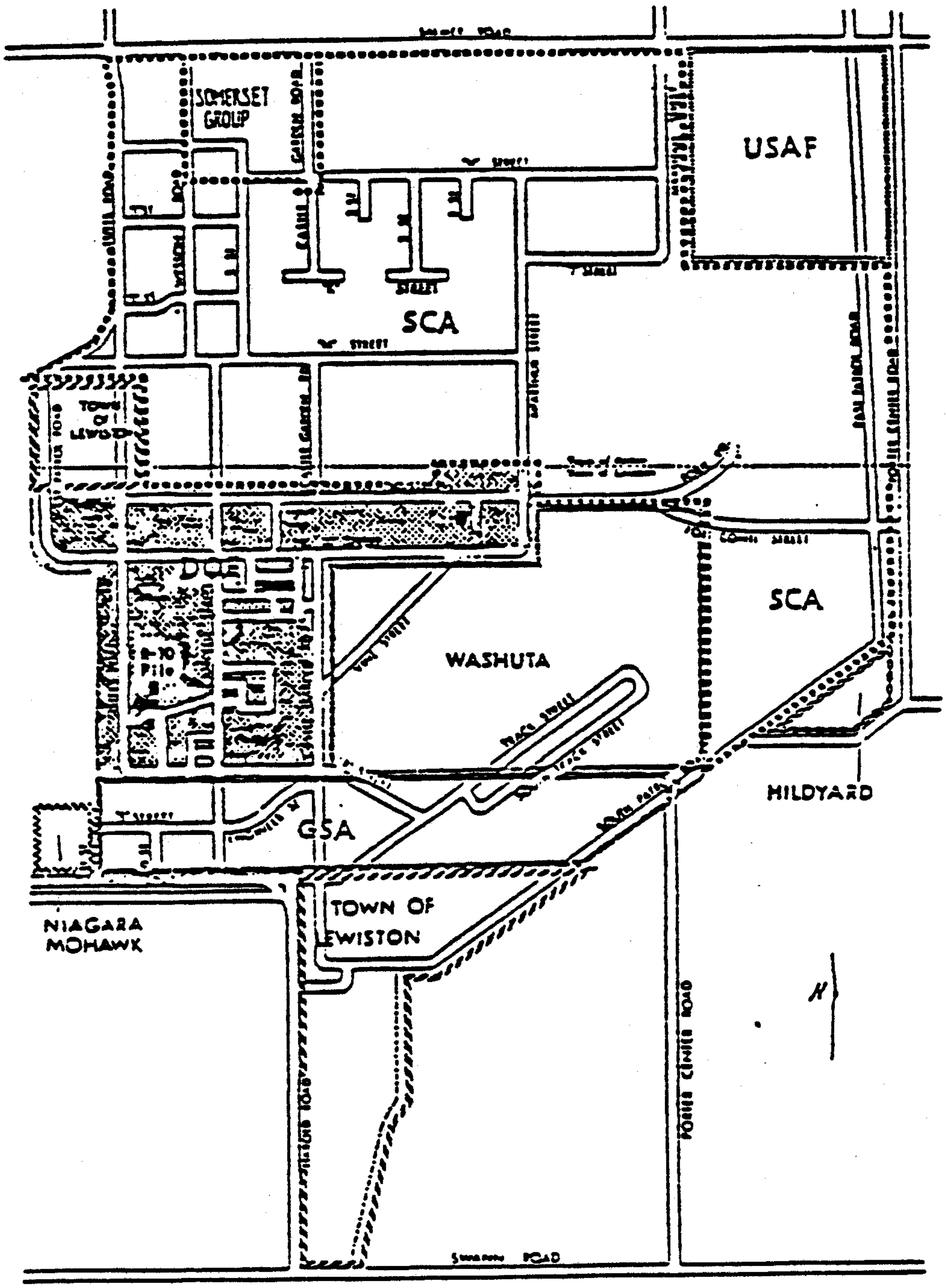

Figure 2. Current Ownership of the Original Manhattan Engineer District Site at the Lake Ontario Ordnance Works.

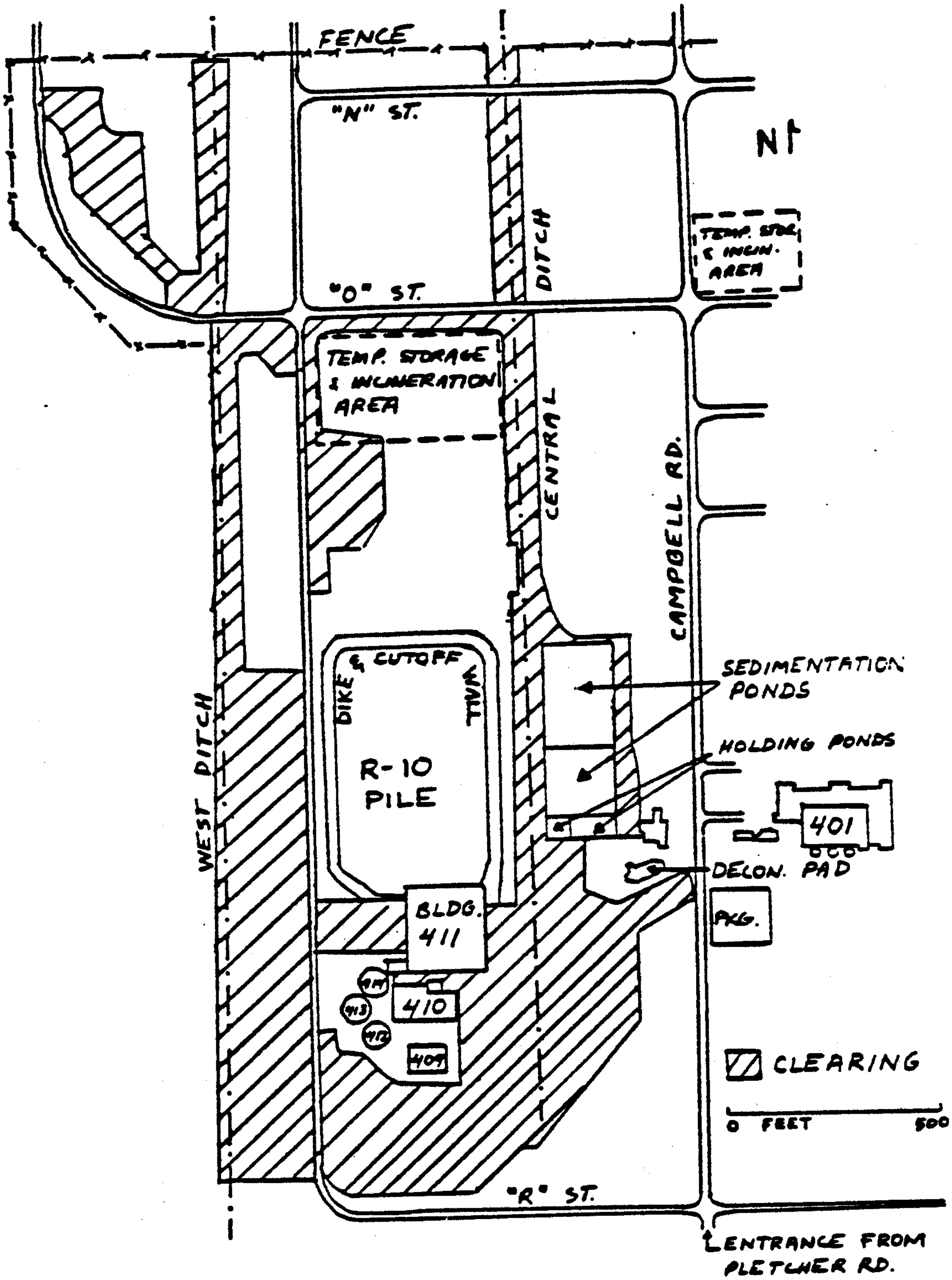

Figure 3. Proposed Onsite Areas to be Cleared. Adapted from Bechtel National, Inc. (1982b and 1982d--Drawings 15-DD07-D-02 and -03). Note: Some of these areas were cleared as part of R-10 add-on work or field change orders during 1982.

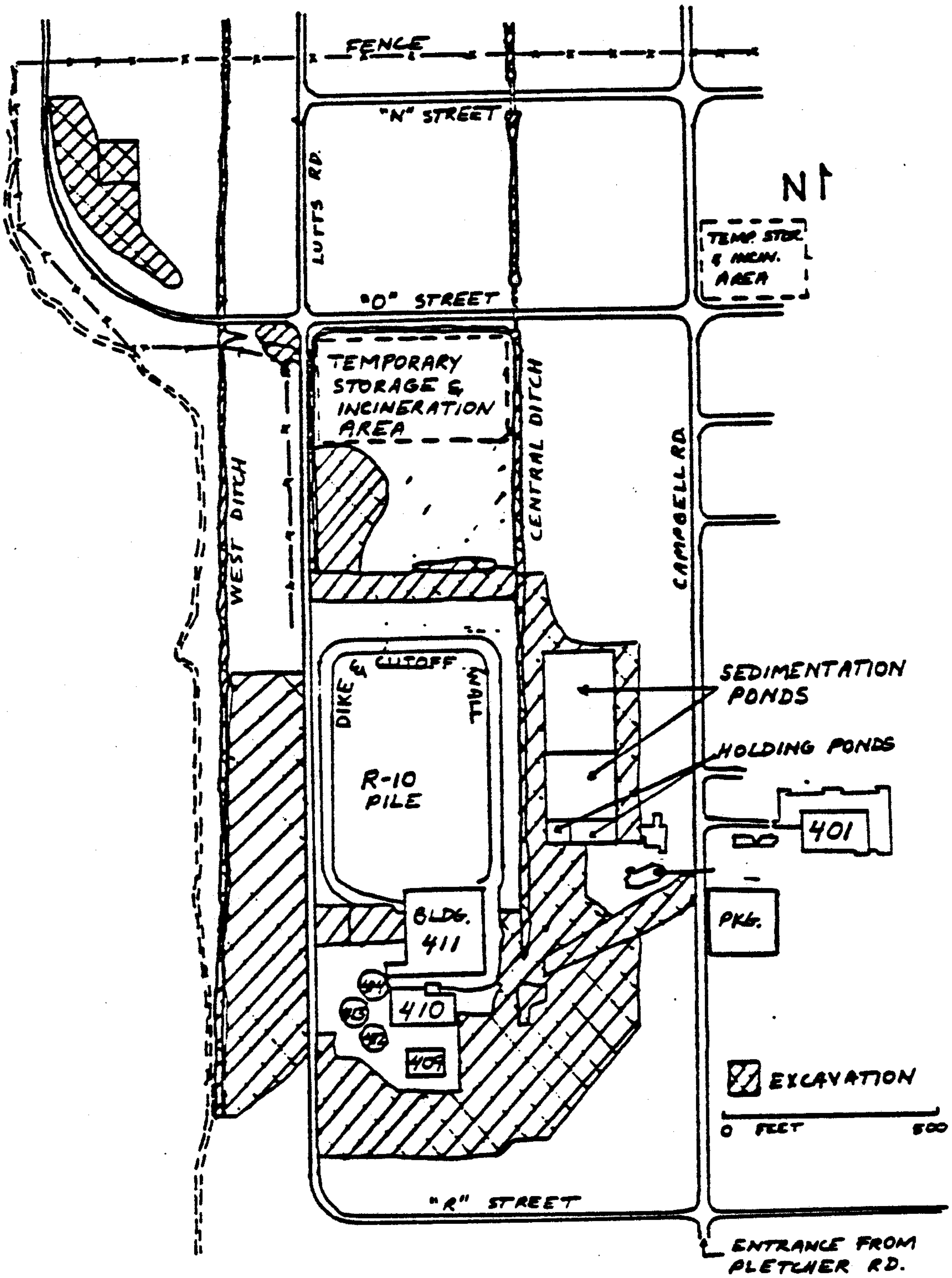

Figure 4. Proposed Onsite Areas to be Excavated. Adapted from Bechtel National, Inc. (1982b and 1982d--Drawings 15-DD07-C-04 and -05). Note: Some of these areas were excavated as part of R-10 add-on work or field change orders during 1982.

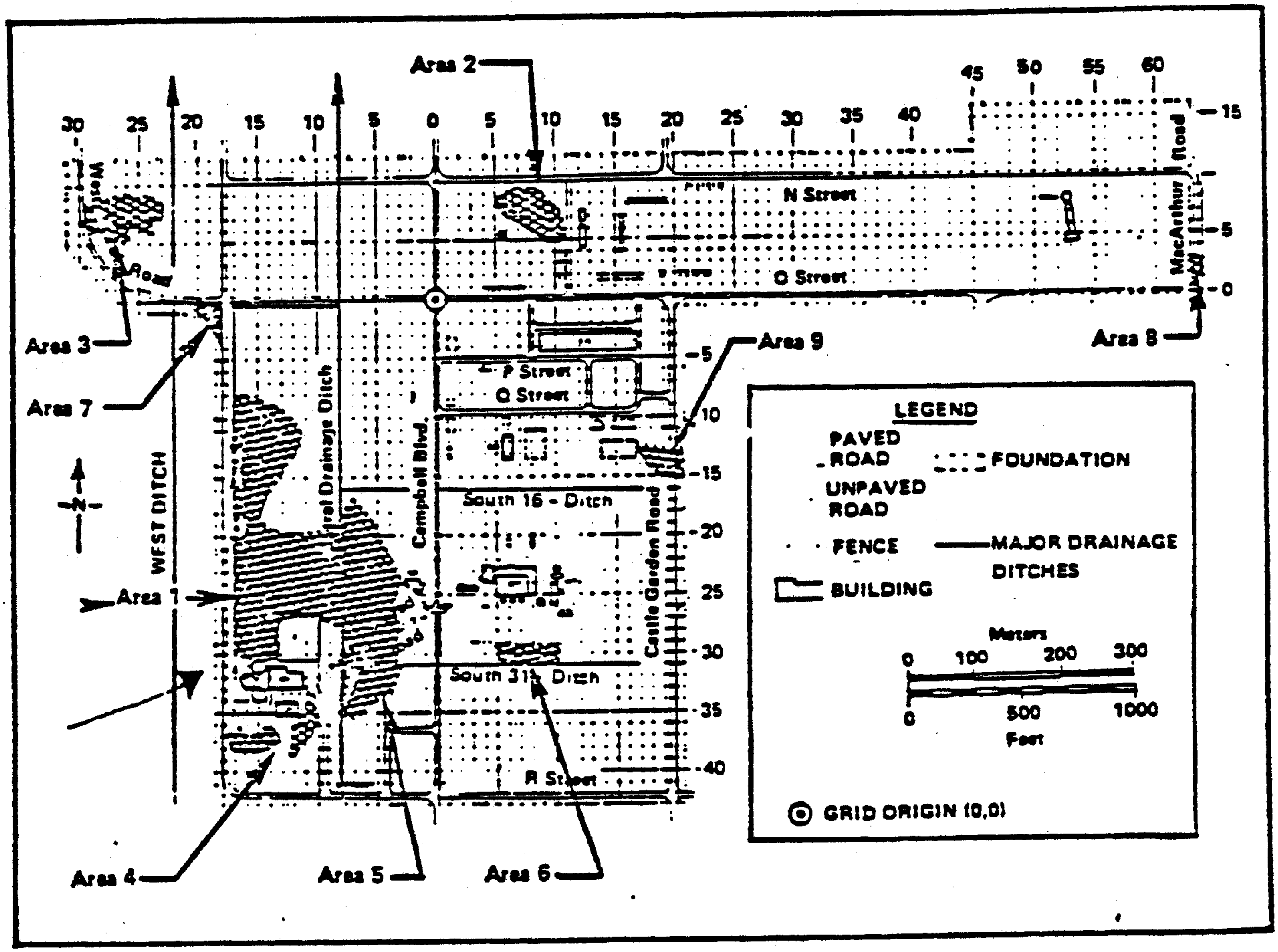

Figure 5. Some of the Contaminated Areas at the Niagara Falls Storage Site. (Contaminated buildings, residues, and ditches not included on the drawing.) Source: Ausmus et al. (1980).

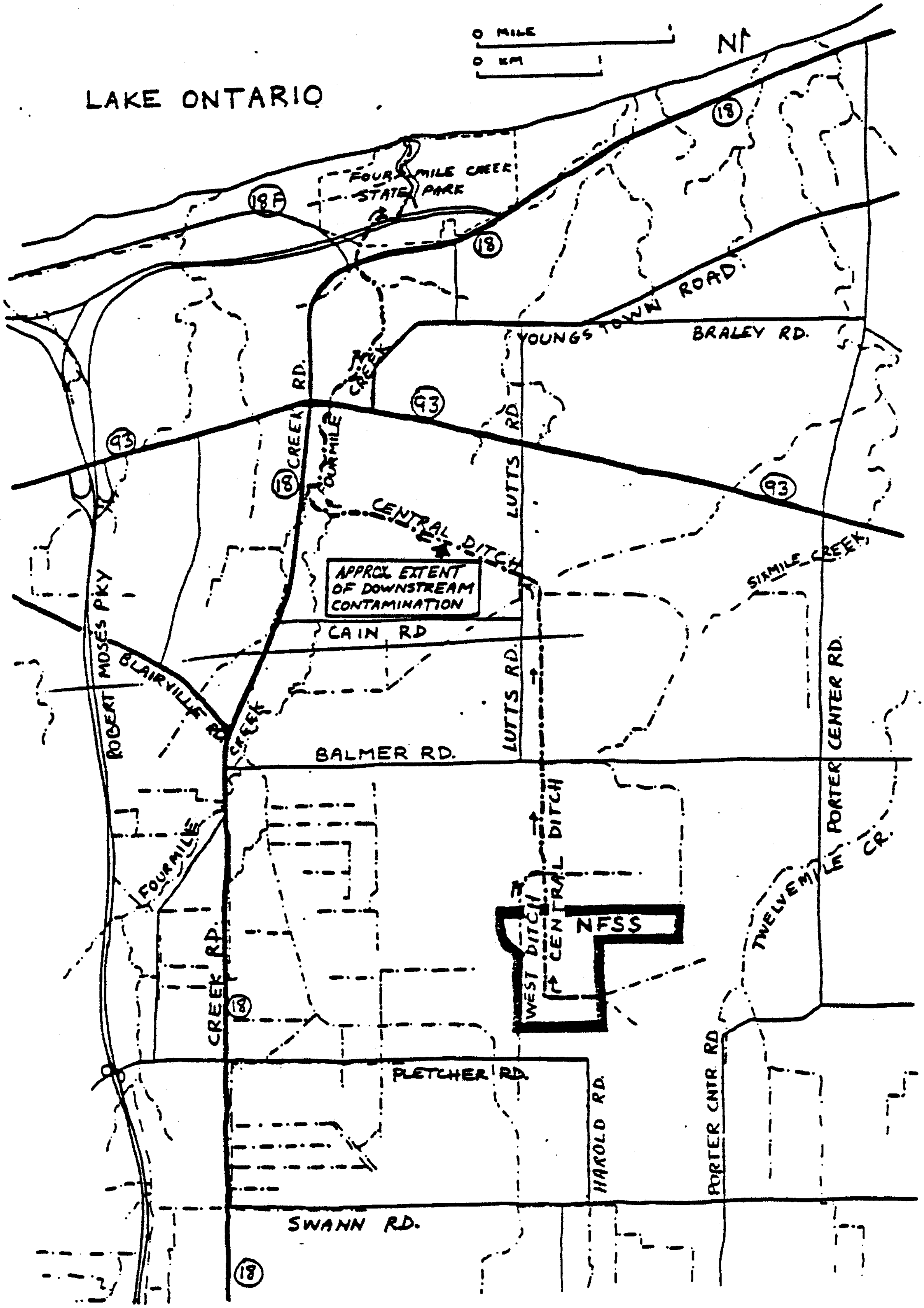

Figure 6. Drainage Ditches, Creeks, and Major Roads Near the Niagara Falls Storage Site. Adapted from U.S. Geological Survey (1965).

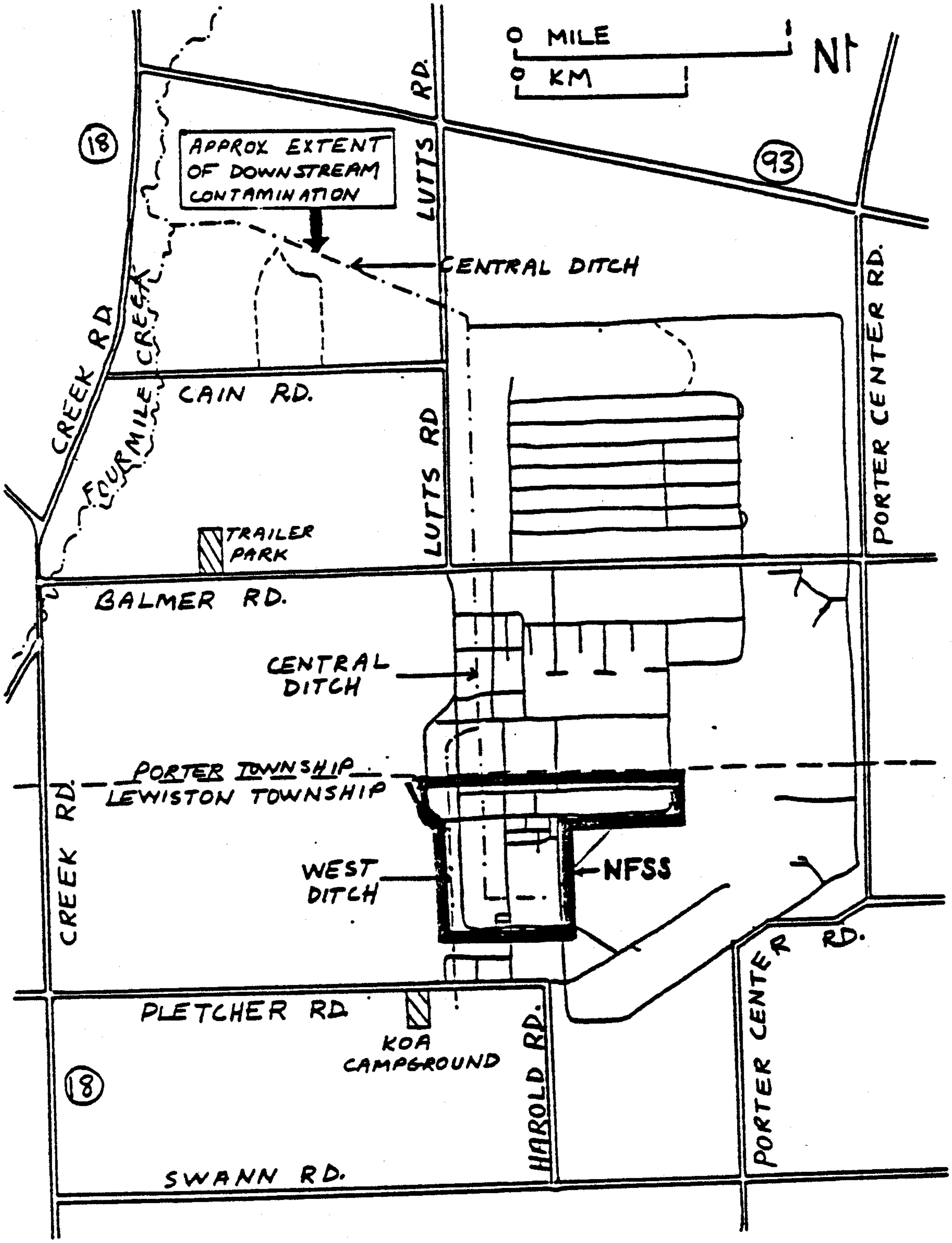

Figure 7. Primary, Secondary and Tertiary Roads (Public and Private) Near the Niagara Falls Storage Site (NFSS) and Central Drainage Ditch. Adapted from U.S. Geological Survey (1965) and 1980 aerial photographs.

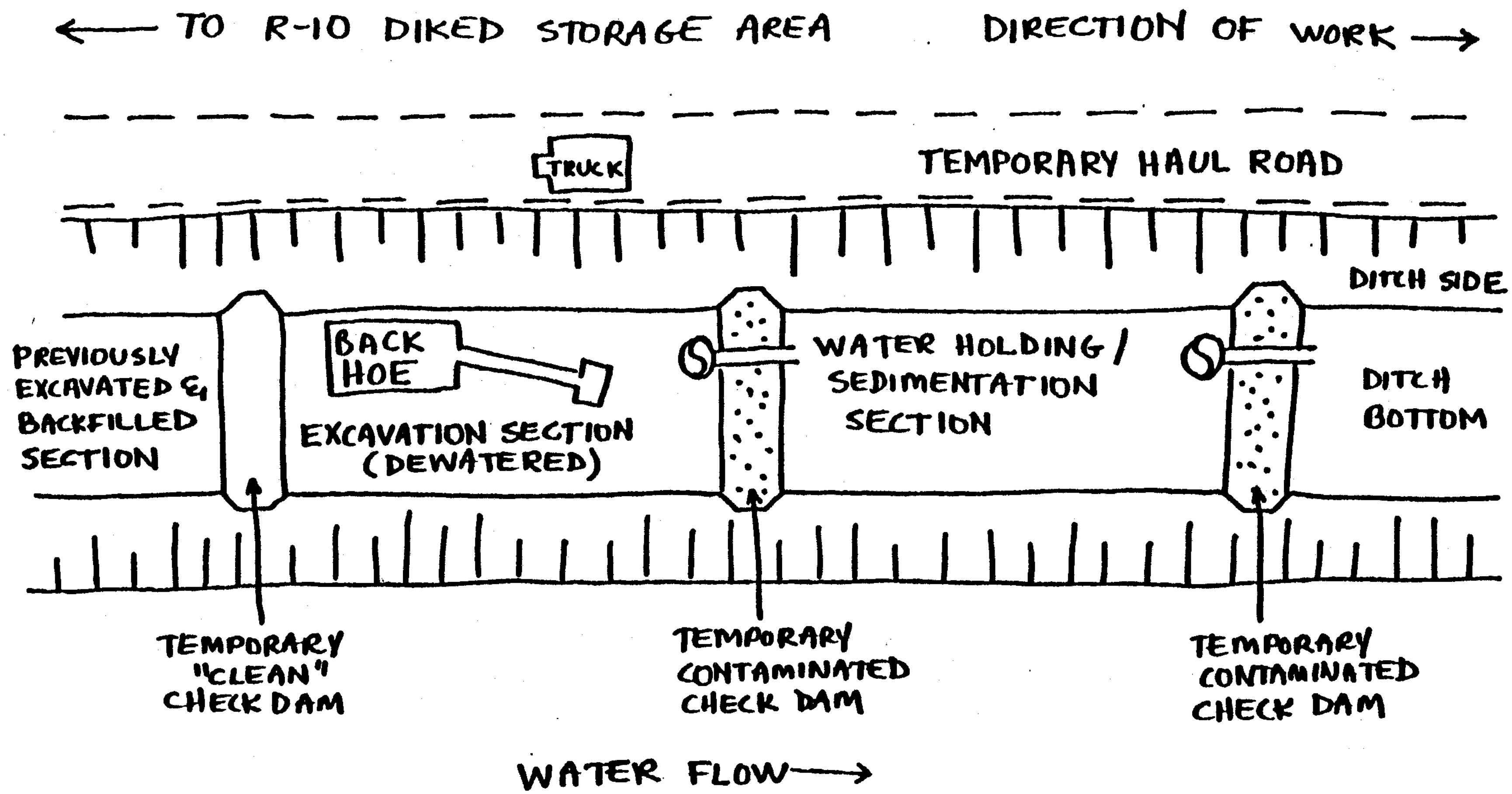

Figure 8. Example of One Method That May Be Used for Ditch Excavation at the Niagara Falls Storage Site (Check Dam/Dewatering System).

Table 1. Radiological Characteristics of Areas to be Excavated

	Surface (1-cm) Beta-Gamma Level†1 (mR/h)	Radium Concentration†2 (pCi/g)
Area 1†3	0.06 - 4†4	4 - 9400†4
Area 3†3	0.05 - 70	0.52 - 6.9†5
Area 4†3	0.15 - 0.65	0.66 - 30
Area 5†3	0.1 - 0.5	1.5 - 131
Area 6†3	0.2 - 2	0.18 - 87
Area 7†3	1 - 2	0.9 - 5
West ditch†6	0.5 - 3	2.6 - 75
Central ditch†6	0.06 - 2.2	2.2 - 1900
Area between Lutts Road and West ditch†3	0.03 - 0.07	0.8 - 120

†1 Background level is 0.06 mR/h.

†2 Background concentration is 1.89 pCi/g. The remedial action criterion to be used for this proposed action is 15 pCi/g above background.

†3 See Figures 4 and 5.

†4 Remedial actions were taken in 1982 in portions of Area 1 that have the higher radium-226 concentrations. Proposed actions for 1983 would be in portions of Area 1 with lower concentrations.

†5 Primary contamination in Area 3 is cesium-137, up to 59,000 pCi/g of soil. The remedial action criterion to be used for this proposed action is 80 pCi/g for cesium-137.

†6 See Figures 4 and 6.

Source: Ausmus et al. (1980).

Table 2. Existing (1975) and Projected (2000) Land Uses for the Towns (Townships) of Lewiston and Porter and for Niagara County

		Percent of Land Area						
Location	Status of Land Use	Residential	Commercial/ Public/ Semipublic	Industrial	Forest/Brush/ Outdoor Recreation/ Vacant	Agriculture	Water/ Wetland	Transportation
Town of Lewiston (25,088 acres)	Existing	7.7	6.2	1.0	32.2	43.5	7.7	1.4
	Projected	8.0	6.5	1.0	32.2	43.2	7.7	1.4
Town of Porter (20,992 acres)	Existing	4.1	4.6	1.5	25.8	61.9	0.3	1.6
	Projected	4.2	4.8	1.5	25.9	61.6	0.4	1.6
Niagara County (341,670 acres)	Existing	6.4	2.1	1.7	19.9	65.3	3.5	0.9
	Projected	6.6	2.2	1.8	19.9	65.0	3.6	0.9

Data from Interstate Commerce Commission (1981).

Table 3. Population Trends for the Towns (Townships) of Lewiston and Porter and for Niagara County

Location	1970†[1]	1980†[1]	1970-1980 (% change)	Projected 2000†[2]	1980-2000 (% projected change)
Town of Lewiston	15,888	16,219	2.1	16,500	1.7
Village of Lewiston	3,292	3,326	1.0		
Town of Porter	7,429	7,251	-2.4	7,800	7.6
Village of Youngston	2,169	2,196	1.2		
Village of Ransomville	1,034	1,101	6.5		
Niagara County	235,720	227,101	-3.7	235,500	3.7

†[1] Data from U.S. Census Bureau, New York Regional Office.

†[2] Year 2000 projections were based on 1980 projections that were 1 to 7% higher than actually occurred. Therefore, year 2000 projections may be too high.

Data from Interstate Commerce Commission (1981).

Table 4. Concentrations of Selected Elements in Residues, Ditch Sediments, and Groundwater at the Niagara Falls Storage Site

	Concentrations (ppm)					
	Residues		Ditch Sediments		Groundwater†[1]	
Element	Bldg. 411†[2]	R-10 Pile	Central†[3]	West	Site Periphery	R-10 Pile Area
Arsenic	32	0.5-5	0.1-10	0.1-3	0.006-0.019	0.002-0.019
Cerium	1300	5-100	2-500	3-20	0.0017-0.003	0.002-0.003
Cesium	1.5	-	-	-	<DL	<DL
Chromium	250	20-30	10-200	10-30	0.008-0.079	0.003-0.11
Cobalt	7500	50-5000	10-5000	3-500	0.001-0.064	0.001-0.080
Copper	3200	20-3000	10-200	5-50	0.006-0.32	0.003-0.062
Fluorine	40	3-100	10-2000	2-20	0.023-0.3	0.021-0.25
Lanthanum	1000	-	1-500	2-10	<DL	<DL
Lead	13,000	3-650	0.3-55	0.2-1.5	0.012-0.026	0.011-0.025
Lithium	200	-	30-300	50-300	0.07-0.44	0.064-0.48
Nickel	40,000	20-5000	50-5000	10-100	0.012-0.037	0.003-0.006
Selenium	50	-	-	-	<DL	1.0
Strontium	250	50-200	30-500	50-300	0.49-10	0.21-11
Uranium	15,000	1000-145,000	-	-	0.006-0.012	0.006-1.2

†[1] The values given are the concentration ranges above the detection limits for those samples that gave positive results. <DL means that no positive result was observed.

†[2] Average of values for residues in east and west bays of Building 411.

†[3] It is not clear whether offsite ditch samples were taken, or whether the results given are limited to onsite samples only.

Source: Ausmus et al. (1980--Tables 3.2, 5.1, 6.6, and 6.7).

Table 5. Governmental Agencies with Potential Regulatory Control Over the Proposed NFSS Interim Remedial Action

Federal	
	Nuclear Regulatory Commission
	Environmental Protection Agency
	Department of Energy
	Department of Transportation
	Corps of Engineers
State of New York	
	Department of Environmental Conservation
	Department of Health
	Department of Labor
	Department of Transportation
	Energy Research and Development Authority
Niagara County	
	Finance, Public Health, and Public Safety Committee
	Health Department
	Board of Health
	Environmental Management Council
	Planning Board
Town of Lewiston	
	Town Board
	Building and Zoning Inspector
	Zoning Board of Appeals
	Environmental Conservation Committee

Data from Politech Corporation (1980).

Table 6. Mitigative Measures and Monitoring That Will Be Part of the Proposed Action

- Controls over further spread of contamination--including establishment of contamination control zones, use of temporary plastic sheeting to cover uncontaminated sides of ditches and truck loading area, use of seamless trucks or truck liners when hauling wet ditch materials, decontamination of vehicles and equipment, erosion and runoff control measures, and worker monitoring.
- Routine watering of excavation areas and the R-10 pile storage area, as necessary during dry conditions, to preclude excessive dust.
- If the check dam/dewatering system is used for ditch excavation, covering the downstream dam of contaminated materials with a tarp, straw, or other material to preclude erosion of the dam materials downstream into uncontrolled areas.
- Prompt seeding and mulching of disturbed areas to minimize erosion; use of scarification and jute netting, as necessary, in ditches.
- Standard contamination and worker radiation-exposure controls; education and training of workers with regard to radiation risks and health-physics procedures; use of breathing apparatus for work in Building 411.
- Routing of trucks hauling contaminated materials one-way along temporary haul roads back to the site; decontamination and restoration of haul roads and repair of other public and private roads, as necessary.
- Use of a flagman on Balmer Road near the Lutts Road and central ditch crossing area to aid in the safe movement of construction equipment across Balmer Road; avoidance of residential areas when transporting backfill; scheduling construction traffic during offpeak hours.
- Air and water quality monitoring for radioactive substances; installation of a water-level monitoring device in Building 411 and routine water-level checks; monitoring of the water from Building 411 for radiological and nonradiological substances prior to discharge, and treatment (as necessary) to reduce concentrations of radionuclides to DOE operating limits and concentrations of nonradiological substances to state discharge limits.
- Sampling and analysis of central ditch sediments from the vicinity of SCA Chemical Waste Services for selected metals and organic compounds; reevaluation of potential nonradiological hazards; revision of the proposed action, mitigating measures, and monitoring, if necessary.
- Monitoring the surface of the R-10 pile for bulges, cracks, or other signs of any buildup of decomposition gases under the EPDM/clay/soil cover.
- Informing local authorities, nearby property owners, and concerned citizens of the proposed action; designating a public liaison person; courteous treatment of site visitors; assurance to interested persons that the public will be involved in any decision-making concerning the long-term, permanent disposition of the site.
- Informing property owners of intended actions along the central drainage ditch; courteous respect for their property rights and interests.

Table 7. Cumulative Radiation Doses to Selected Members of the General Public Near the R-10 Pile During Proposed FY 83 Actions†[1]

Description of Person	Location of Person	Dose (mrem)			
		Whole Body	Bone	Lung	Bronchial Epithelium
KOA campground visitor (1-week visit)	0.7 km SSW	<0.010	0.018	0.014	0.022
KOA campground attendant	0.7 km SSW	0.20	0.35	0.38	0.57
Nearest permanent resident	1.1 km SW	0.015	0.14	0.15	0.20
Trailer park resident	2.6 km NW	0.015	0.037	0.035	0.040
SCA Chemical Waste Services worker	1.2 km NNE	0.027	0.39	0.42	0.32

†[1] Bases for radiological analysis are given in the text.

Table 8. Comparison of Doses to SCA Chemical Waste Services Worker to Doses from Other Sources†[1]

From Proposed Action	Compares With
0.027 mrem (whole body)	Riding 5 minutes in a jet plane at 10,000 m (33,000 ft) because of increase in cosmic radiation with altitude
	Staying for the same amount of time as the remedial action (6 months) at 1.8-m (5-ft) higher altitude
0.39 mrem (bone)	36 mrem received from natural sources (background) over the same period of time (6 months)
0.42 mrem (lung)	260 mrem received from background over the same period of time

†[1] Conversion factors given in the Argonne National Laboratory (1982) report.

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NY.17 Plan S0799
(1.12) Survey
(1.4.2.7) Schedule
Sample
ORAU

PROPOSED SURVEY PLAN FOR OFF-SITE PROPERTY F AT THE FORMER LAKE ONTARIO ORDNANCE WORKS LEWISTON, NEW YORK

INTRODUCTION

Beginning in 1944, the Manhattan Engineer District and its successor, the Atomic Energy Commission (AEC), used portions of the Lake Ontario Ordnance Works (LOOW), Lewiston, New York, for storage of radioactive wastes. These wastes were primarily residues from uranium processing operations, however, they also included: contaminated rubble and scrap from decommissioned facilties, biological and miscellaneous wastes from the University of Rochester, and low-level fission-product waste from contaminated liquid evaporators at the Knolls Atomic Power Laboratory (KAPL). Receipt of radioactive waste was discontinued in 1954, and, following cleanup activities by Hooker Chemical Co., 525 hectares of the original 612 hectare LOOW site were declared surplus. This property was eventually sold by the General Services Administration to various private, commercial, and governmental agencies. The Department of Energy (DOE) has determined that portions of these properties still contain low-level radioactive residues from earlier operations.

Service Corporation America (SCA) is the current owner of a 21 hectare tract identified as area F (see Figure 1). This property is almost entirely used by SCA for landfills, salts areas, and ponds. Much of the original land surface has been disturbed. There are no buildings on the site, and the land is essentially free of brush and weeds.

There is no evidence of burial of contaminated material on the property; however, some temporary storage is likely to have occurred. Any contamination from previous activities has probably been relocated during disturbances of the site by SCA. Previous surveys have identified spotty

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March 14, 1983

contamination and elevated direct radiation levels along the streets forming the property boundaries. In the southeast corner of the site higher direct radiation levels are present due to shine from the nearby K-65 storage tower.

SURVEY PLAN

Objective

The objective of the survey is to provide a comprehensive assessment of the radiological conditions and associated potential health effects, if any, on the property. Radiological information collected will include:

1. Direct radiation exposure rates and surface beta-gamma dose rates.

2. Locations (if any) of elevated surface residues.

3. Concentrations of radionuclides in surface and subsurface soil.

4. Concentrations of radionuclides in surface and ground water.

Procedures

1. Site Preparation

    a. Brush and weeds will be cleared, as needed, to provide access for gridding and surveying. This operation will be performed by a subcontractor.

    b. A 40 m grid system will be established by an engineering survey firm under subcontract. This grid system will be referenced to existing state and/or local property survey markers. Subdivisions (5 m) of this grid will be performed by the ORAU survey team in the southeast section of the property and at other locations, as appropriate, based on findings of contaminated areas as the survey progresses.

c. The engineering firm which grids the property will also prepare drawings of the property, indicating superficial land features and the grid pattern.

2. Walkover surface scans will be conducted over accessible areas of the entire site. Traverses will be at approximately 5 m intervals except in areas where direct radiation levels suggest possible contaminated residues; traverse intervals will be 1-2 m in those areas. Portable gamma-ray scintillation survey meters will be used for the scans. Locations of elevated contact radiation levels will be noted.

3. Gamma-ray measurements will be made at the surface and 1 m above the surface at each grid line intersection and at locations of elevated readings (see item 2), using a portable gamma-ray scintillation survey meter. Conversion of these measurements to exposure rates in microroentgens per hour will be in accordance with cross calibration with a pressurized ionization chamber.

4. Beta-gamma dose rate measurements will be made 1 cm above the surface at each grid line intersection and at locations of elevated readings identified by the walkover scan. These measurements will be made using a portable thin-window (7 mg/cm^2) G-M survey meter. Readings will be expressed as beta-gamma dose rate in microrads per hour.

5. Surface (0-15 cm) soil samples will be collected at each grid line intersection and from areas of elevated surface contact levels identified by the walkover scan (item 2 above).

6. Ground penetrating radar surveys will be performed in areas where elevated direct readings indicate possible concentrations of contaminated residues. Ground radar will also be performed at

the proposed locations of all boreholes to assure avoidance of subsurface utilities during drilling.

7. Boreholes will be drilled to collect subsurface soil and ground water samples. Systematic subsurface sampling to ground water depth (3 to 7 m) will be performed at approximately 7 locations (see Figure 1), evenly spaced to provide representative sampling of the total property.

   Additional deep (3-7 m) and shallow (to 1-2 m) boreholes will be drilled to adequately characterize residues. Locations, numbers, and depths of these additional boreholes will be determined in the field on the basis of other survey findings and ground radar data. Shallow (to 1-2 m) holes will be drilled by ORAU using portable augers; other drilling will be performed by a subcontractor using a truck-mounted hollow-stem auger. SCA representatives will be consulted prior to drilling to ensure that this activity can be performed without endangering survey personnel or damaging SCA facilities.

8. Additional biased measurements and samples will be obtained as required, based on the findings during the survey. The need for these will be determined by the field survey team leader.

9. Samples of sediment will be collected from ditches, and samples of standing water will be obtained from ditches and other surface sources as available.

10. Samples of water, soil, and sediment will be collected from the Lewiston area (but not on former LOOW property) to provide baseline concentrations of radionuclides for comparison purposes. Direct background radiation levels will be measured at locations where baseline soil samples are collected. Between 6 and 10 samples of each type of media will be obtained; locations selectd will include at least one sampling site from each of the four major directions from the property being surveyed. Sampling will be from areas accessible by the general public.

Sample Analysis and Interpretation of Results

Soil and sediment will be analyzed by gamma spectrometry. Major radionuclides of interest in this analysis are Ra-226, Cs-137, and U-235; however, spectra will be reviewed for other gamma emitters. Additional analyses will be performed if gamma spectrometry and direct radiation measurements suggest possible significant concentrations of other radionuclides, e.g. Sr-90, U-238. Water samples will be analyzed for gross alpha and gross beta levels. If these levels indicate that EPA drinking water standards may be exceeded, further analysis for specific radionuclides will be conducted. Results of this survey will be compared to applicable guidelines for formerly utilized radioactive materials handling sites (refer to attached table).

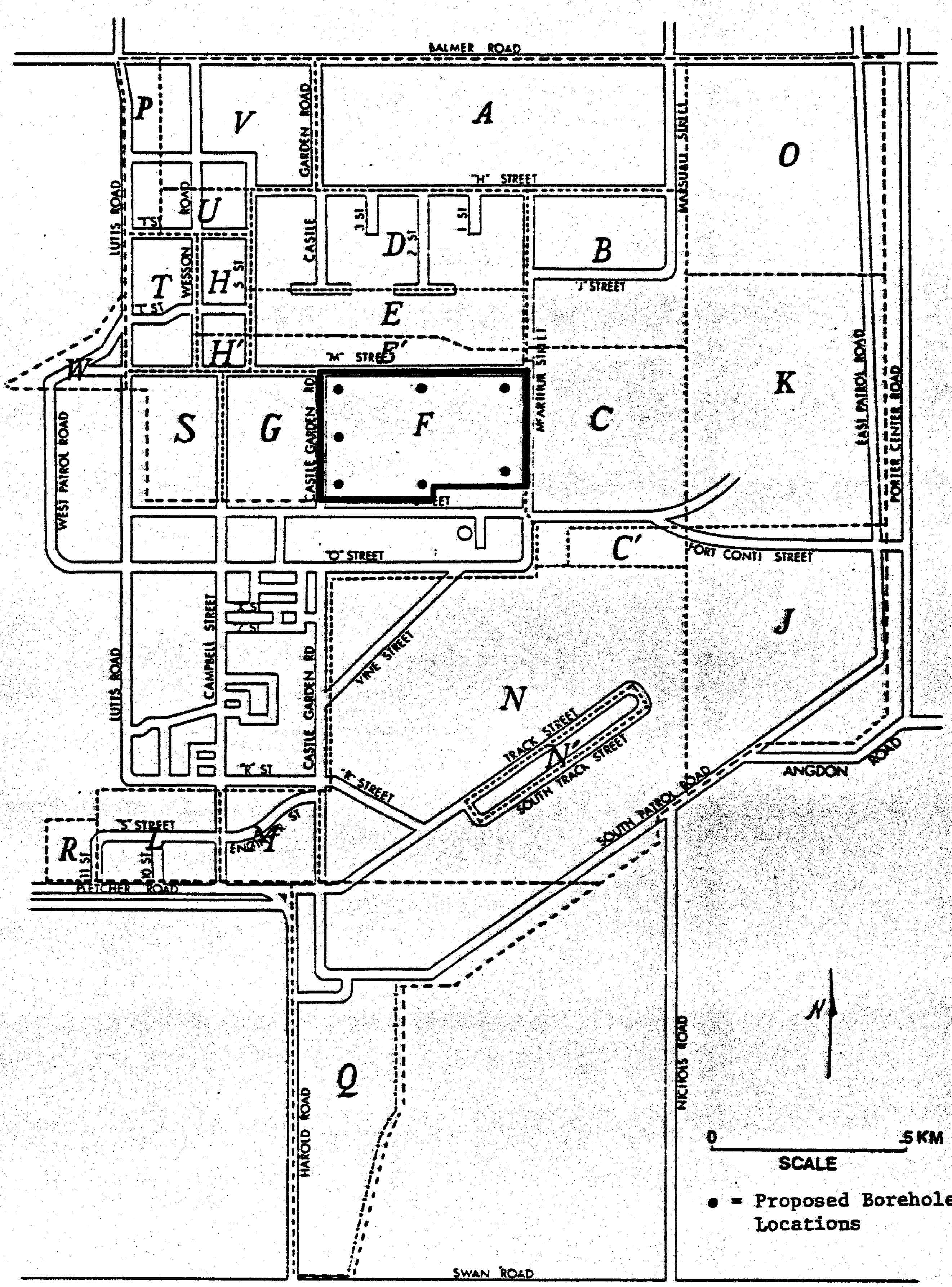

FIGURE 1. LOOW Site Indicating the Location of Property F and Proposed Locations of Systematic Boreholes.

SUMMARY OF RADIATION GUIDELINES
APPLICABLE TO OFF-SITE PROPERTIES AT THE FORMER LOOW SITE

Mode of Exposure	Exposure conditions	Guideline value	Guideline source
1. External gamma radiation	Continuous exposure to individual in general population (whole body)	60 μR/hr	Nuclear Regulatory Commission (NRC) Standards for Protection Against Radiation (10 CFR 20.105)
	Indoor gamma reduction (above background)	20 μR/h	EPA Standards for Uranium Mill Tailings
2. Surface alpha contamination[a]	Ra-226 contamination fixed on surfaces	100 dpm/100 cm^2	NRC Guidelines for Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-product, Source, or Special Nuclear Material (Adapted from NRC Reg. Guide 1.86)
	Removable Ra-226	20 dpm/100 cm^2	
3. Surface beta contamination[a]	Removable beta-gamma	1000 dpm/100 cm^2	Same as number 2
4. Beta-gamma dose rate	Average dose rate on an area no greater than 1 m^2	0.20 mrad/h	Same as number 2
	Maximum dose rate in any 100 cm^2 area	1.0 mrad/h	Same as number 2
5. Exposure to radon	Maximum permissible concentration of Rn-220 in air in unrestricted areas	3.0 pCi/l	NRC 10 CFR 20.103, Appendix B, Table II
	Average annual radon daughter concentration (including background)	0.020 WL	EPA Standards for Mill Tailings
6. Radionuclides in water	Maximum contaminant level for combined Ra-226 and Ra-228 in drinking water	5 pCi/l	EPA Interim Drinking Water Standards
	Maximum permissible concentration of the following radionuclides in water for unrestricted area:		NRC 10 CFR 20.103 Appendix B, Table II
	Ra-226	30 pCi/l	
	U-238	40,000 pCi/l	
	Th-230	2,000 pCi/l	
	Pb-210	100 pCi/l	
7. Radionuclides in soil	Ra-226 concentrations averaged over 100 m^2 (above background)	5 pCi/g (surface) 15 pCi/g (subsurface)	EPA Standards for Mill Tailings

[a] Applicable to building and equipment surfaces only.

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ACTION DESCRIPTION MEMORANDUM
NIAGARA FALLS STORAGE SITE
PROPOSED INTERIM REMEDIAL ACTIONS FOR
FY 1983-85 ACCELERATED PROGRAM

Prepared by

Environmental Research Division
Argonne National Laboratory
Argonne, Illinois

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Second Draft: May 1983
Third Draft: May 25, 1983
Final: June 20, 1983

Prepared for

U.S. Department of Energy
Oak Ridge Operations
Technical Services Division
Oak Ridge, Tennessee

CONTENTS

SUBJECT: Proposed Interim Remedial Actions for FY83-85 Accelerated Program at the Niagara Falls Storage Site

SUMMARY OF PROPOSED ACTION AND RELATED ACTIVITIES

As part of its Surplus Facilities Management Program (SFMP) and Formerly Utilized Sites Remedial Action Program (FUSRAP), the U.S. Department of Energy (DOE) proposes to carry out an accelerated interim remedial action project during FY 1983-1985 at its Niagara Falls Storage Site (NFSS) in Niagara County, Lewiston Township, New York (Figure 1). The accelerated program will involve relocation of some of the radioactive residues stored at the site, extension of a dike and subsurface clay cutoff wall (trench), and construction of an interim clay cap over the entire diked area in the southwest corner of the site. The major project actions include:

- Removal of the wooden roof on Building 411 and slurry transfer of the L-30 and F-32 residues to the east bay of Building 411.
- Slurry transfer of the K-65 residues from Building 434 ("K-65 tower") to the west bay of Building 411.
- Dewatering of the K-65 and the combined L-30/F-32 residues
- Extension of the dike and subsurface clay cutoff wall south around Buildings 411, 413, 414, and the foundation of 410.
- Demolition of Buildings 401, 401A, 409, 412, 415, 434, and the abovegrade portion of 410; placement of the resulting contaminated rubble within the new south diked area
- Excavation of approximately 3,000 m^3 (4,000 yd^3)* of contaminated** soil materials from remaining onsite contaminated areas and placement of the excavated materials over the dewatered K-65 residues in Building 411.

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*The volume to be excavated is being revised upward as a result of further radiological surveys and a revision in the cleanup criterion for radium-226 from 15 pCi/g to the U.S. Environmental Protection Agency (EPA) mill tailings criterion (see next footnote).

**For this proposed action, contaminated soil materials will be defined as those materials having a concentration of radium-226 greater than 5 pCi/g above natural soil background (averaged over the top 15 cm of soil) and greater than 15 pCi/g (averaged over any 15 cm below the top layer). This is the EPA standard for cleanup of dispersed uranium mill tailings (U.S. Environ. Prot. Agency 1983).

- Backfilling of remaining void areas within the south diked area with about 21,000 m^3 (27,000 yd^3) of uncontaminated ("clean") soil materials* and construction of an interim clay cap over both the north and south diked areas.

Details of these activities are given in the section "Proposed Action and Alternatives".

This work is a continuation of interim remedial work begun in 1982 as part of DOE's ongoing maintenance and caretaker operations at NFSS. The 1982 and previously proposed 1983 work consisted of: (1) consolidation and stabilization of the R-10 pile, (2) construction of a dike and subsurface clay cutoff wall around the R-10 pile (north diked area), (3) removal of wooden roofs on Buildings 413 and 414 and construction of a multilayer cover system over the L-50 residues stored in Buildings 413 and 414, and (4) clearing and excavation of ditches (both onsite and offsite) and of other contaminated areas in the southwest part of the site (U.S. Dep. Energy 1982a, 1982b, 1983a).

Throughout all interim actions, the site will continue to be under DOE ownership and used solely for continued storage of radioactive wastes and residues. The site is fenced and access is limited. Planning is currently underway for the long-term disposition of the site (U.S. Dep. Energy 1983b); however, no specific preferred action is being proposed at this time.

HISTORY AND NEED FOR ACTION

The current 77-ha (190-acre) DOE Niagara Falls Storage Site is part of the former 610-ha (1500-acre) Manhattan Engineer District (MED) site (Figure 2), which in turn was part of the former Lake Ontario Ordnance Works (LOOW). Beginning in 1944, the MED used the site for storage of radioactive residues that resulted from the processing of uranium ores (pitchblende) during development of the atomic bomb. Additional residues were brought to the site for several years after World War II.

Subsequent to the MED, responsibility for the site has been transferred to the U.S. Atomic Energy Commission, the U.S. Energy Research and Development Administration, and the U.S. Department of Energy. The site is currently administered by the Oak Ridge Operations Office of DOE, and activities are limited to maintenance, caretaking, and ongoing interim remedial actions.

About 60% of the 18,000 m^3 (24,000 yd^3) of residues stored at NFSS currently belong to Afrimet-Indussa, and the remaining residues belong to the U.S. government (Table 1). Afrimet, an American firm incorporated in the State of New York, is apparently controlled by Union Miniere, a Belgian firm. The Afrimet residues account for less than 10% of the total volume of contaminated materials at NFSS but almost 99% of the radium-226 inventory (Table 2). Afrimet supplied the federal government with uranium ore (pitchblende) from

*Ongoing radiological surveys may indicate the need for excavation of some vicinity properties near NFSS (Aerospace, Inc. 1982). Contaminated materials from these properties would be placed within the south diked area, thus reducing the need for clean backfill materials. Cleanup of these properties is not part of the currently proposed action.

the Belgian Congo but retained ownership of the residues because of the then-valuable radium and other potentially recoverable, valuable elements that remained in the residues after the uranium was extracted. Afrimet currently holds a license from the state of New York (a U.S. Nuclear Regulatory Commission agreement state) for storage of the radioactive materials at NFSS. Afrimet also holds a storage lease agreement with DOE, but this lease expires June 30, 1983, and DOE is currently discussing lease termination conditions with Afrimet.

Building 411 is part of a complex of concrete and wooden buildings in the southwest portion of NFSS (Figure 3) that were originally designed for water treatment and storage. There are about 6,500 m^3 (8,500 yd^3) of Afrimet-owned residues (L-30 and F-32 residues) currently stored in bulk in two large concrete vaults (east and west bays) and a recarbonation pit; most of the residues are in the west bay. There are about 96 Ci of radium-226 in the L-30 and F-32 residues combined; this represents about 10% of the total radium-226 inventory that will be stored at NFSS as of completion of the accelerated interim remedial actions in 1985 (Table 2). About 70% (by volume) of the residues is chamosite clay.

As part of the 1982 interim remedial actions, the L-30 residues above the water level in the west bay of Building 411 were washed down and the residues in the east bay were wetted down. Also, water from Building 410 was transferred to the east bay of Building 411. As a result, most of the residues are now under water, and the levels of radon daughter products in the air above the residues have been reduced from about 24 WL (working level) to 1 WL (Levesque 1983).

The Afrimet-owned K-65 residues are located in the northeast corner of the site in both the upper and lower sections of a reinforced concrete silo (Building 434, "K-65 tower") that was originally designed as a water tower (Figures 3 and 4). The 3,000 m^3 (4,000 yd^3) of K-65 residues have a total of about 775 Ci of radium-226; this represents about 88% of the radium-226 inventory at NFSS (Table 2). Although the tower has been reinforced with two layers of concrete (Figure 4), it is questionable whether the tower would be able to withstand the maximum-expected earthquake for the site (Acres American Inc. 1981a).

More detailed information on the extent of the radioactive contamination on and near the site as well as possible alternatives for disposition of the Afrimet residues and the entire NFSS can be found in: U.S. Atomic Energy Commission (1974); Cavendish et al. (1978); Ausmus et al. (1980); Acres American Incorporated (1981a, 1981b, 1981c); Anderson et al. (1981); Battelle Columbus Laboratories (1980); Bechtel National, Inc. (1982a, 1982b); Aerospace, Inc. (1982); and U.S. Department of Energy (1983b).

SETTING

The Niagara Falls Storage Site is located in Niagara County in Western New York (Figure 1), within the town (township) of Lewiston and adjacent to the town (township) of Porter. It is about 30 km (19 mi) north of Buffalo, New York; 10 km (6 mi) north of the city of Niagara Falls; 6.5 km (4 mi) south of Lake Ontario; and 5 km (3 mi) east of the Province of Ontario, Canada.

There are several buildings and private roads on the fenced-in site (Figure 3). The site is zoned industrial and is currently used only for storage of radioactive residues and soils. Prior to commencement of the interim remedial actions in 1982, most of the site was covered with second-growth forest, shrubs (brush), grasses, and marsh vegetation. Due to clearing associated with surveys and preparation for excavations, only about one-third of the site is now covered with second-growth forest. Surface water flows into the west and central ditches and subsequently into Fourmile Creek and Lake Ontario (Figure 5). The channeled ditches are overgrown with cattails. Water flow, when it occurs, is generally slow (Ausmus et al. 1980), except during spring melt when the flow may be rapid; much of the time there is essentially no flow at all. A national flood insurance map indicates that the 100-year floodplain is contained within the drainage ditches (U.S. Dep. Housing Urban Dev. 1980). Replacement of ditch culverts (under previously proposed interim actions [U.S. Dep. Energy 1983a]) is intended to ensure that floods are contained within the ditches.

Land uses immediately adjacent to the site are varied. A hazardous-waste-disposal facility operated by SCA Chemical Waste Services is located north and east of the site. A sanitary landfill is being constructed to the east by Modern Disposal, Inc. South of the site is federal government property controlled by the U.S. Department of Labor and used for training construction equipment operators. There is also a sanitary landfill south of the site, which is owned by the town of Lewiston. West of the facility is a Niagara Mohawk Power Corporation transmission line corridor (Acres American Inc. 1981a). The current ownership of the land that was once part of the original MED site is shown in Figure 2.

Land uses within the towns (townships) of Lewiston and Porter are predominantly rural and include row-crop agriculture, orchards, recreation areas, old abandoned fields, and second-growth forests (Table 3). These areas are projected to remain rural through the year 2000. A recreational area, Fourmile Creek State Park, is located at the confluence of Fourmile Creek and Lake Ontario, about 3 km (2 mi) downstream from the central ditch (Figure 5).

The nearest permanent residence is an apartment at the KOA campground 0.7 km (0.4 mi) southwest of Building 411. There is a trailer park 2.6 km (1.6 mi) northwest on Balmer Road, and the Lewiston-Porter Central Schools are located 2.4 km (1.5 mi) west of the site on Creek Road (Figure 6). SCA Chemical Waste Services personnel work outdoors north of the site (1.2 km NNE of Building 411). During the summer, there are campers at the KOA campground 0.7 km (0.4 mi) southwest of Building 411 on Pletcher Road (Figure 6). Hunters occasionally use the area west of the Niagara Mohawk corridor.

The population of Niagara County, which has declined since 1970, was about 227,000 in 1980, and population growth to the year 2000 is projected to be minimal (Table 4). Local town (township) and village population statistics are presented in Table 4. The nearest major population centers are the city of Niagara Falls (about 71,000) and the Buffalo metropolitan area (about 1.5 million). As of May 1982, Niagara County had a civilian work force of about 104,000, with an unemployment rate of 13.6%.

Major highway transportation routes in the area are State Route 93 to the north, U.S. Route 104 to the south, and the Robert Moses Parkway to the west (Figure 1). Local roads near the site include Lutts, Creek, Balmer, Pletcher, and Porter Center roads (Figure 6).

Niagara County has a humid, continental climate that is moderated by the lake effects of Lakes Erie and Ontario. Average annual precipitation is 83 cm (33 in.), which is fairly evenly distributed throughout the year. Approximately 140 cm (56 in.) of snow falls, primarily between November and March (Acres American Inc. 1981a). The wind is predominantly from the southwest.

The NFSS is located 6.5 km (4 mi) from the southern shore of Lake Ontario, 3.2 km (2 mi) north of the Niagara Escarpment (Figure 1), on the relatively flat terrain of the Erie-Ontario Lowlands Physiographic Province. Elevations at the site range between 93 and 102 m (310 and 336 ft) MSL; the lower elevations correspond to the man-made drainage ditches and the higher elevation is the top of the R-10 waste area. Most of the site is at about 98 m (320 ft) MSL. Creeks and drainage ditches on the site and surrounding areas are shown in Figure 5. About one-third of the site has soils that remain saturated throughout the year and are covered by marsh-type vegetation.

Geologically, the region is characterized by approximately 15 m (50 ft) of overburden that is underlain by a 274-m (900-ft) sequence of Ordovician-age shales and siltstones of the Queenston Formation. The overburden material is composed of glacial and recent alluvial deposits and includes dense tills, glaciolacustrian clays, and numerous lenses of glaciofluvial sands and gravels (Acres American Inc. 1981a, 1981b).

At NFSS, groundwater is present in both the glacial/alluvial deposits and bedrock and generally flows towards the northwest. There are essentially three aquifers underlying NFSS: (1) an unconfined, perched soil aquifer in a series of extensive sandy silt or silty sand lenses 3 to 6 m (10 to 20 ft) below the ground surface, (2) a continuous, confined soil aquifer within the brown silty sand unit approximately 9 to 12 m (30 to 40 ft) below ground surface, which is contiguous with (3) a confined bedrock aquifer within the weathered upper meter of the Queenston Formation (Acres American Inc. 1981b; Bechtel Natl. Inc. 1982d, 1982e). The groundwaters of all aquifers underlying NFSS have high concentrations of sulfate and calcium and are of low quality for drinking water (Acres American Inc. 1981a). No ranges or seasonal variations of radionuclide concentrations in groundwater have been published to date. Background concentrations for the site and region have not yet been established.

Various state and local governing bodies may have jurisdiction over or concern about the proposed accelerated remedial action at NFSS (Table 5). Local residents and interest groups have also shown interest and concern about the site. Newspaper articles have appeared, and private citizens have written letters to DOE and the U.S. Environmental Protection Agency (EPA). A Citizen's Oversight Committee was formed by U.S. Representative John LaFalce in response to public questions raised concerning the potential health hazards at the site (LaFalce 1980). Representative LaFalce has indicated that the purpose of this committee is to advise him regarding NFSS and to work with DOE to ensure that DOE's proposals are sound and acceptable to the committee. In a recent report to New York Assembly Speaker, Stanley Fink, regarding federal involvement in several hazardous-waste sites in the Niagara Falls area (Zweig and Boyd 1981), NFSS was mentioned as posing a potential hazard to public health and safety. Since October 1982, there have also been numerous newspaper articles about potential DOE long-term actions at the site and about discharges of contaminated water. As part of the scoping process for the Environmental Impact Statement (EIS) that DOE is preparing to support a decision on the long-term disposition of the wastes and residues stored at NFSS (U.S. Dep. Energy 1983b), members of the public, elected officials, and state agencies have commented on the proposed accelerated interim actions--particularly the K-65 residue transfer. Awareness and concern about radioactive and other hazardous wastes have been heightened by publicity about the nearby Love Canal toxic waste problem, the nearby West Valley high-level-radioactive waste project, and the Three Mile Island nuclear power plant accident (Zweig and Boyd 1981; U.S. Dep. Energy 1982c).

PROPOSED ACTION AND ALTERNATIVES

Following is a detailed preliminary description of the various activities included in the proposed accelerated remedial action program. Specific activities may vary slightly from the descriptions given herein as a result of ongoing engineering design analyses.

Residue Transfer and Dewatering

The wooden roof of Building 411, which is currently in a state of disrepair (partially collapsed), will be removed first to allow access for residue transfer and dewatering equipment. The roof materials will be stored onsite with other wooden materials, pending future incineration.

The L-30 residues in Building 411 will remain covered with water. The small amount of L-30 residues currently present in the east bay will be transferred to the west bay via an hydraulic "slurry" mining process. This transfer will take about one-half month. Following the transfer, the wall that partially divides the east bay into two sections will be completed, and a vacuum dewatering system--consisting of wicks, a bottom layer of sand, a filter fabric, and slotted plastic pipes--will be installed in the east bay (Figure 7).

All the L-30 residues will then be slurry transferred from the west bay to the east bay, and the F-32 residues will be slurry transferred from the recarbonation pit to the east bay. This transfer process is expected to take about one month.

Slight modifications to the slurry transfer process are currently being considered, such as: (1) installation of a test dewatering system in the recarbonation pit and transfer of some of the L-30 residues from the east bay to the pit, (2) installation of the dewatering system in the easternmost half of the east bay first, followed by transfer of the residues from the west to the east half of the east bay, and (3) installation of the dewatering system in the westernmost half last, followed by transfer of the bulk of the residues from the west bay to the east bay. The outer walls and floor of Building 411 will be carefully inspected for cracks and sealed, if necessary, prior to installation of the dewatering systems.

The combined L-30/F-32 residues will then be dewatered as follows. After the residues have settled, an asphalt emulsion will be sprayed onto the residue surface under water (Figure 7) to act as a radon barrier.* The water on top will be pumped to either the basement of Building 410 or to a newly constructed 950-m^3 (250,000-gal) temporary slurry-water holding pond near the K-65 tower (Figure 3) and saved for later use in transfering the K-65 residues. A vacuum will then be applied to the plastic pipe system, causing water to move down the wicks, through the sand, into the horizontal drain pipes at the bottom, and up through the vertical pipes. This water will also be saved for later use in the K-65 residue transfer. This dewatering process is expected to take about four months, and the final residue moisture content is expected to be about 30%. Tests that were recently performed on the L-30 and K-65 residues to allow better prediction of settling behavior and performance of the dewatering system indicate that initial dewatering may take six months.

When the west bay of Building 411 is empty (Figure 7), a dewatering system (similar to the east bay system) will be installed.

The hydraulic mining equipment will then be moved to a newly constructed platform atop the K-65 tower (Figure 4). A hole will be opened in the roof of the K-65 tower to provide access for the slurry mining equipment. The K-65 residues will be slurry-transfered in batches via a 1.6-km (1-mi) long, 10-cm (4-in.) diameter carbon-steel welded pipeline to the west bay of Building 411. The water stored in the nearby EPDM-lined holding pond (Figure 3) will be used for this purpose. About 260 m^3 (340 yd^3) of residues can be transfered in one batch at a rate of 950 L/min (250 gal/min) of slurry. The transfer pipeline will be flushed after each batch. When the residues have settled for a few hours, the water on top will be transfered back via the pipeline to the holding pond near the tower, supplemented as necessary with water stored in the basement of Building 410 (from L-30 residue dewatering). Each batch transfer and recharge of the slurry-water holding pond will take about two days.

About a third of the residues can be transfered in one-half month using the equipment mounted on top of the tower.** Then the equipment will be moved to another platform constructed part way down the side of the tower (Figure 4).** A hole will be made in the side of the tower to allow access to the residues. This setup on the side of the tower will take about one-half month. The remainder of the residues will then be transfered in about one month, including the time required to make another hole in the floor (located about halfway up the tower) to allow access to the remainder of the residues in the bottom of the tower.

During the transfer, the K-65 residues in Building 411 will be covered with water. Upon completion of the transfer, the residues will be dewatered in a manner similar to that described for the combined L-30/F-32 residues. It is expected that it will take about four months to dewater the K-65 residues to a 30% moisture condition. The water from this dewatering will be routed through the existing onsite sedimentation holding ponds and water-treatment system (Figure 3) to remove radium-226 and uranium-238 to levels prescribed in DOE Order 5480.1A for offsite release (30 pCi/L for radium-226 and 600 pCi/L for

*Other membranes, instead of asphalt, are also under consideration.

**The use of a crane instead of platforms is also being considered.

uranium-228) and to remove other elements to levels prescribed in the SPDES permit currently under final approval by the state of New York (New York Dep. Env. Conserv. 1983). The water will then be discharged to the central ditch (Figure 3). [See previous Action Description Memorandum (U.S. Dep. Energy 1983a) for detailed description of the water-treatment system.]

After all residues have been dewatered, about 0.5 m (1.5 ft) of contaminated clay soil materials excavated from elsewhere on the site (see later discussion) will be dumped on top of the K-65 residues to reduce radiation levels. Workers will then be able to gradually place and compact additional layers of contaminated soil materials, totaling about 2.4 m (8 ft).* Finally, about 0.6-1.2 m (2-4 ft) of compacted "clean" clay* will be placed over the entire building (Figure 8).

Due to funding constraints, lead time on purchase of equipment, and undesirability of winter operations, it is expected to take about two years to complete the above activities. The L-30 and F-32 residue transfer will occur in FY 1983 and the K-65 residue transfer in FY 1984.

Dike Extension, Miscellaneous Excavation, Demolition, and Construction of Interim Cap

The dike and subsurface clay cutoff wall will be extended to the south around Buildings 411, 413, and 414 (Figure 10). About 7,100 m^3 (9,300 yd^3) of clay will be needed for the cutoff wall and 4,100 m^3 (5,400 yd^3) for the dike. Construction methods will be similar to those used during construction of the north diked area in 1982. A trench will be excavated to a depth of about 6-8 m (20-25 ft) to the gray clay layer to provide a barrier within the upper layer of mixed clay and sand lenses. Ongoing geohydrological investigations will enable more precise definition of the depth of the south cutoff wall. Clay will be backfilled into the trench and compacted to 90% theoretical maximum density. The dike will be constructed similarly of compacted clay on top of the subsurface cutoff wall. The outside of the dike will be covered with riprap (rocks) to protect the dike from erosion.

About 3,000 m^3 (4,000 yd^3)** of contaminated soil materials will be excavated from Areas 2 (New Naval Waste Area), 8, and 9 (Figure 3). These soils will be placed on top of the K-65 residues in Building 411, as described previously. Excavated areas will be backfilled with clean soils.

Buildings 401, 401A, 409, 412, 415, 434, and the abovegrade portion of 410 (Figures 3 and 9) will be demolished, and contaminated rubble (about 4,600 m^3 [6,000 yd^3]) will be placed in the new south diked area. Uncontaminated rubble will be used for riprap on the sides of the dikes. Building 434, which previously housed the K-65 residues, will be demolished by

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*The amount of contaminated soil materials is being revised upward based on further radiological surveys, a revision of the cleanup criterion (see previous discussion), and a revision in the estimates of compaction of the residues due to dewatering. As a result, the amount of "clean" clay would be decreased.

**The volume to be excavated is being revised upward as a result of further radiological surveys and a revision in the cleanup criteria (see previous discussion).

conventional means after it has first been washed down with high-pressure water to dislodge residue particles remaining after the slurry transfer operation (thereby reducing the potential for airborne contamination).

It is expected that the dike construction, contaminated soils excavation, and demolition of buildings will be completed by the fall of 1984.

Upon completion of the abovementioned activities, any remaining contaminated areas on the site will be cleaned up and the contaminated materials will be placed in the diked area. The liners and any contaminated sediments in and under the temporary slurry-water holding pond, sedimentation ponds, and clean-water holding ponds will be cleaned up. Contaminated water-treatment filters, resins, and sediments will also be placed in the diked area.

Finally, the remaining void space within the diked area will be filled with approximately 21,000 m^3 (27,000 yd^3) of clean backfill.* An earthern cap will then be constructed over the entire 3.4-ha (8.5-acre) diked area (Figure 10). The cap will consist of a layer of reinforced synthetic rubber (EPDM), 0.9 m (3 ft) of compacted clay, 0.2 m (0.5 ft) of sand, and 0.5 m (1.5 ft) of soil. About 55,000 m^3 (71,000 yd^3) of clean fill materials will be required for cap construction (Table 6). The cap will be seeded with grass.

Over the three years of the proposed accelerated actions, about 100,000 m^3 (130,000 yd^3) of clean fill materials, primarily clay, will be brought to the site (Table 6). It is anticipated that the L-30 residue transfer and dewatering will take place during 1983, the K-65-residue transfer and dewatering during 1984, and the final site cleanup and construction of the interim cap during 1985. The work force will be slightly larger for the accelerated actions than during the 1982 interim actions; i.e., a total of 100, including 30 management and monitoring personnel brought in from outside the area. It is expected that construction workers will be affiliated with local Niagara County unions, as was the case during the 1982 work.

A summary of mitigative measures and monitoring that will be part of this proposed action is given in Table 7.

There are five basic alternatives to this proposed action: (1) defer all accelerated activities until permanent disposition of NFSS can be determined (no action), (2) defer only the construction of the interim cap until permanent disposition can be determined, (3) defer transfer and dewatering of the L-30 and K-65 residues, as well as construction of the interim cap, until permanent disposition can be determined, (4) package the L-30 and K-65 residues, store them in Building 411 or other existing buildings at NFSS, and defer construction of the interim cap until a decision is made on permanent disposition, and (5) immediately remove all the residues and contaminated materials involved in the proposed action to some other site for long-term management. Following is a discussion of each alternative.

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*Ongoing radiological surveys may indicate the need for excavation of some vicinity properties near NFSS (Aerospace, Inc. 1982). Contaminated materials from these properties would be placed within the south diked area, thus reducing the need for clean backfill materials. Cleanup of these properties is not part of the currently proposed action.

Alternative 1. Because the permanent disposition of NFSS is unlikely to be determined for about two years and may not be implemented for an intermediate time thereafter, DOE considers it prudent to continue the interim program of bringing the site under better control, thus eliminating the no-action alternative.

Alternative 2. Construction of the interim cap is the final step needed to bring the contaminated materials under interim control and is therefore included as part of the proposed accelerated interim remedial action program. It is currently anticipated that the cap will be constructed in 1985 and that the decision on long-term disposition will be made in late 1984 or early 1985. Thus, it is possible that DOE may decide to proceed directly with whatever alternative is chosen for the long-term management of the wastes, without constructing the interim cap.

Alternative 3. The K-65 residues are currently located in an old concrete tower that is seismically unstable. These residues are the most radioactive of all the residues and contaminated materials stored at NFSS, amounting to 88% of the total radium-226 inventory (Table 2). It is necessary to move them to a more stable location. DOE currently has funding to move the residues to Building 411 and considers it prudent to do so as part of its ongoing maintenance and caretaker responsibilities under the interim action program, pending the later decision on the long-term disposition of NFSS.

Alternative 4. Construction of packaging facilities for the L-30 and K-65 residues and modification or construction of storage facilities would be required to implement this alternative. Funds are currently not available for this. Furthermore, bulk storage in Building 411 is considered to be sufficient for bringing the site under interim control. The long-term management of the residues will be addressed in the forthcoming EIS (U.S. Dep. Energy 1983b).

Alternative 5. DOE is considering removal to other sites in its ongoing decision-making process on long-term management of the NFSS residues and wastes. As noted previously, an EIS is being prepared to support this decision, and the EIS should be finalized within the next two years.

POTENTIAL ISSUES AND ANALYSIS

Using the information given in the previous sections, as well as the methods of analysis discussed in a report by Argonne National Laboratory (1982), the following potential issues were identified and assessed.*

Radiological

A major potential issue is the radiological impact associated with the proposed accelerated interim remedial actions. The predominant pathway by which radionuclides could reach nearby workers and members of the general public during the proposed actions is inhalation of radioactive products such

*Potential issues assciated with the previously proposed FY 1983 interim remedial actions (which are in addition to the actions proposed under the accelerated program) are discussed in a separate ADM (U.S. Dep. Energy 1983a).

as those from decay of radon gas (one of the radionuclides in the decay chain of the uranium-238 found at NFSS). Other pathways (such as inhalation of contaminated dust particles, external dose from submersion in a cloud of dust, external dose from radioactive particles deposited on the ground, or internal dose from ingesting contaminated food or water) are expected to be relatively insignificant (Argonne Natl. Lab. 1982).

The bases for the analyses of potential dose to nearby individual members of the general public and to the entire population within an 80-km radius of the proposed action are described below.

Radioactive releases for the five major activities that constitute the proposed accelerated remedial actions were estimated using the following assumptions.

(1) The L-30 and F-32 residue transfer occurs in two parts: (a) transfer of one-tenth of the L-30 residues from the east bay to the west bay of Building 411 over a half-month period, and (b) transfer of all the L-30 residues and the F-32 residues to the east bay of Building 411 over a one-month period. It was assumed conservatively that the entire available* radon inventory would be released from the residues as they are transferred.

(2) The combined L-30/F-32 residue dewatering, immediately following Activity 1, occurs over a four-month period. This is followed by a one-year period during which the residues are stored beneath only the asphalt layer while Activities 3 and 4 proceed. The residues would cover an area of 1,700 m^2 (18,000 ft^2). It was conservatively assumed that 10% of that area would have no asphalt covering (allowing for cracks at the edges of building walls/pillars/pipes/etc. and for cracks that might develop as the residues settle during the dewatering process), whereas the remaining 90% would have a 5-cm (2-in.) layer of asphalt. The radon source term, calculated on the assumption that the gas would escape from 10% of the area during the storage period (one year), proved to be negligible in comparison to the source terms that represent the transfer operations. Radon release during dewatering was estimated to be even less than during storage.

(3) K-65 residue transfer occurs over a 1.5-month period. It was assumed that the entire available radon inventory would be released, primarily at Building 411 (where the residues will be dispersed over the large, open west bay) rather than at the tower (mostly an enclosed space with only small access holes and small residue surface area).

(4) K-65 residue dewatering occurs over a four-month period. Assumptions, similar to those applied to the L-30/F-32 residue dewatering, resulted in the prediction of an entirely negligible release of radon during this activity.

*A radon emanation power of 0.2 is assumed. Thus, only 20% of the radon in the residues can be released during the transfer activities. The other 80% remain trapped inside the residue particles.

Activities 3 and 4 were assumed to occur during the final 5.5 months of the one-year period of storage of the combined L-30/F-32 residues (see Activity 2).

(5) Excavation and placement of contaminated soils over the K-65 residues occurs over a two-month period commencing upon completion of Activity 4. The 3,000 m^3 (4,000 yd^3) of contaminated soils has an average radium-226 concentration of 50 pCi/g (based on the average of data for Area 2 given in Anderson et al. 1981). Since dust emissions from similar activities have been shown to be about 0.05% of the total volume hauled (U.S. Environ. Prot. Agency 1977), it was assumed that 3,800 kg (8,400 lb) of contaminated dust would be released.

Additional assumptions are:

- The releases caused by Activities 1 through 4 occur continuously. The release from Activity 5 is assumed to occur only 10 hours/day, 5 days/week, during the two-month period.

- No dust is released by Activities 1 through 4 because the residues are always in water or highly saturated.

- The release height above ground level at Building 411 is 3 m (10 ft).

- Each nearby individual member of the public is conservatively assumed to be outdoors during the hours the releases take place.

- Buffalo meteorological data are considered to be representative of conditions at the site and, therefore, are used as they were in the previous radiological analysis for the FY 1983 ADM (U.S. Dep. Energy 1983a).

Assuming that the mitigative measures discussed in Table 7 are employed, potential doses to individual members of the public near the proposed action are predicted to be low (Table 8). Doses to the bronchial epithelium are estimated to be higher than doses to the bone and lung because the major release associated with the proposed accelerated actions is radon gas and its decay products are deposited selectively on the bronchial tissue. The predicted whole-body doses are similar in magnitude to doses received while spending 4 minutes on a jet plane at high altitudes or spending 19.5 months (the time required to complete the remedial action) at an altitude that is 2 m (7 ft) higher (Table 9). Specific organ doses (e.g., bone and lung) are lower than doses received from natural sources (Table 9).

The radiological impact of the proposed remedial activities on the surrounding population was evaluated in terms of the 100-year environmental dose commitment (EDC). This EDC results from radionuclides released during the 19.5 months of remedial work; however, because some of these radionuclides have long half-lives, exposure to radiation from the released radionuclides will continue beyond the 19.5 months of release. Thus, the EDC includes the dose commitment that would occur during the 19.5 months of remedial work and the smaller dose commitment that would occur over the next 100 years as a result of continued exposure to radiation.

The EDCs to several organs and the whole body were calculated for the U.S. population of 1.2 million people (1980 census) residing within 80 km (50 miles) of the site. These EDCs are listed in Table 10 along with the dose this population will receive from natural background sources of radiation during an equal period of time (19.5 months). A conservative estimate is that the dose from radon decay products to the bronchial epithelium will be increased temporarily by 0.1-0.2%. Other dose commitments are predicted to increase less than 0.01% because of the proposed action.

A small transitory (19.5-month duration) increase in the dose commitment to the Canadian population within 80 km of the site will also occur. It is expected to represent a fractional increase of the same order of magnitude as the dose to the U.S. population from the remedial action. The EDC to the entire population of the Niagara Falls region from the remedial action will have negligible (i.e. essentially zero) impact on the health of the residents.

Doses to workers will be controlled and limited to less than those specified by DOE regulations for occupational doses (e.g., whole-body doses of 3000 mrem/quarter or 5000 mrem/year). Workers will be trained regarding radiation risks and proper health-physics procedures. Workers in close proximity to the L-30 and K-65 residues will wear protective clothing and will be supplied with a special breathing apparatus, as necessary (Table 6).

The potential for an accidental spill during the residue transfer operations, particularly during the K-65 residue transfer, could also be an issue. Spills could range from small leaks at pipe and equipment connections to a larger release due to a pipeline break. Although the pipeline will be welded steel and the total transfer time only 1.5 months, the consequences of a break were assessed using the following assumptions:

- The volume of slurry lost during a spill would be 10 m^3 (13 yd^3), based on the amount that would be lost if it took about 10 minutes to shut down the operation after a break occurred. This corresponds to about 2.0 m^3 (2.6 yd^3) of residues, assuming a slurry consisting of 30% residues by weight. Based on an average radium-226 concentration of 217,000 pCi/g in the K-65 residues (Table 2), about 0.76 Ci of radium-226 would be spilled.

- The spill is assumed to spread over a 100-m^2 (120- yd^2) area, necessitating excavation of about 40 m^3 (50 yd^3) of contaminated soils with an average radium-226 concentration of 12,000 pCi/g.

- It is assumed that it would take two workers one day to remove the contaminated soil materials. The workers are assumed to spend one hour in a 20 mrem/h radiation field (i.e., standing very near to or on top of the contaminated area), 4 hours in a 2 mrem/h field (i.e., operating cleanup equipment), and 3 hours in a 0.2 mrem/h field.

- The material would be wet, thus producing little or no dust or radon release. If the material began to dry during the cleanup operation, it would be wetted down to ensure minimal releases of contaminated dust and radon. If necessary, the workers would be supplied with masks and/or a clean supply of air.

The major radiological impact associated with the spill would be the radiological doses to the two workers. The major source of exposure would be from external gamma radiation because the materials will be wet, thereby resulting in minimal releases of radon gas and contaminated soil particles. The external gamma dose to each worker would be 30 mrem using the assumptions given previously. For comparison, the occupational dose limit under DOE Order 5480.1A for the whole body is 3000 mrem per calendar quarter and 5000 mrem for the entire year. Thus, worker exposures would be well below DOE operating limits.

Another radiological issue may be whether the decontamination criterion for the contaminated areas at NFSS will be considered sufficient. The criterion to be used is the EPA standard for cleanup of dispersed uranium mill tailings (U.S. Environ. Prot. Agency 1983). Furthermore, based on a recent detailed study (U.S. Dep. Energy 1983c, 1983d), DOE believes that this criterion is conservatively low considering any potential adverse health effects that might occur in the future from any residual contamination. Release of the cleaned-up areas for other uses is not part of the proposed action. Such release will be subject to a separate DOE decision in the future.

The adequacy of the sedimentation pond/water treatment system with respect to discharge of radioactively contaminated water has been raised as an issue, particularly since the emergency release of water from the system in the fall of 1982. Sedimentation alone will be insufficient treatment to allow discharge of slurry water. The water will have been in contact with the stored residues sufficiently long to lead to high concentrations of dissolved radionuclides and of fine particles that do not readily settle out. Therefore, these waters will be treated in a system consisting of a radium-specific DOW medium, a uranium-specific medium, a charcoal filter, and ion-exchange resins. No water will be released unless concentrations of radioactive substances are at or below DOE operating limits, even if additional equipment must be added (see later discussion of nonradiological substances in the discharge).

The sufficiency of the water discharge criteria for radioactive contaminants has also been raised as an issue. Although the discharge will be at or below DOE operating limits, a discharge at or slightly lower than the established limits may not be considered to be "as low as reasonably achievable" (ALARA). However, the water-treatment system was tested during 1982 and was successful in removing contaminants from runoff water from the north diked area. Although it will be more difficult to remove contaminants from the more highly concentrated slurry water, every effort will be made to reduce contaminant levels below DOE operating limits.

Physical and Biological

The adequacy of the sedimentation/holding ponds to retain runoff water may be an issue. The system has been designed to accommodate a 10-year storm event, but a sequence of rainfalls of lesser magnitude over a short period of time could stress the system. Water will therefore be treated and released as quickly as permitted under the SPDES permit, thus maximizing the holding capacity of the system.

The adequacy of the sediment/treatment system with respect to discharge of nonradiological chemical pollutants may also be an issue. The primary source of chemically contaminated water will be the water from residue dewatering. The elements regulated by the SPDES permit, particularly the metals, will be both dissolved in the water and associated with fine clay particles that will not readily settle out. Contaminant concentrations in the untreated water are expected to greatly exceed state discharge limits; thus, careful treatment will be necessary to reduce contaminant concentrations to permitted levels. It is expected that the SPDES permit will be granted prior to the planned FY 1983 actions. (See also discussion on SPDES permit under socioeconomic issues.)

In addition to the previously mentioned water quality issues, a potential issue associated with the transfer of the K-65 residues to Building 411 is the possible migration of contaminants from the building via any connections to the near-surface groundwater through the building foundation. However, the building walls and floors will be carefully inspected and repaired, where necessary. Existing pipes around the building will be removed and/or grouted. Thus, during an interim period of about 10 years, little or no migration of contaminants from the residues through the building foundation is expected to occur. Also, the near-surface groundwater will be intercepted by the dike and subsurface cutoff wall surrounding the building, thus substantially reducing the rate of any contaminant migration from the containment area. The potential issue of any long-term migration will be addressed during the decision-making process on the long-term management of the NFSS.

The proposed transfer and dewatering of the L-30 and K-65 residues also raises the issue that this action may be a premature commitment of resources if it is found that the residues must be moved again by a slurry method for removal from NFSS and long-term management elsewhere or for preparation of the residues for management in a different form. However, as discussed under the previous section on the proposed action and alternatives, the ultimate disposition of the site will not be decided for about two years and may not be implemented for an indeterminate time thereafter. Furthermore, funding is currently available to place the residues in a more stable condition. Therefore, DOE considers the proposed transfer and dewatering to be prudent caretaker actions.

The durability of the interim cap over the waste containment area may be an issue. During the 25-year design life of the cap, the clay overlying the EPDM layer may become saturated during spring snowmelt or during periods of intense rainfall. With possible frost penetration to depths of 0.9-1.2 m (3-4 ft) in the Niagara Falls area, cracks could develop in the clay cover as a result of frost heaving. Such cracks could facilitate the infiltration of water through the clay to the EPDM layer. Slippage of the overlying earthen material along the clay/EPDM interface could occur as a result of the 1:10 slope, the possible saturation of the clay, and the presence of water at the EPDM/clay interface. The DOE will monitor the cap condition during the interim control period and will make any necessary repairs.

Socioeconomic

The major potential socioeconomic issue associated with the proposed action is public apprehension that this interim action may lead to establishing NFSS as a permanent radioactive-waste disposal site. However, as discussed previously under alternatives to the proposed action, DOE believes that it is prudent to take the proposed interim action as part of its ongoing caretaker and maintenance responsibilities at the site. Apprehensions should be reduced by the mitigative measures presented in Table 7--such as informing the public about the proposed interim action and assuring them that they will be involved in any decision-making concerning the long-term, permanent disposition of the site.

A socioeconomic issue that has been raised by the state of New York and the town of Lewiston during the EIS scoping process is the desirability of packaging the K-65 and L-30 residues rather than placing them in bulk form in Building 411. If it is later decided to remove these residues from NFSS, such removal would be facilitated because the residues would already be packaged. However, as noted previously under the discussion of alternatives, this would require construction of packaging facilities and modification or construction of storage facilities, for which funds are not currently available. DOE believes it is prudent to remove the residues from the tower and place them in a more stable condition in Building 411 pending the decision on long-term disposition of the residues.

Another potential socioeconomic issue is the increased traffic on local roads, particularly trucks hauling the 100,000 m^3 (130,000 yd^3) of fill materials to the site (Table 6), and the potential for increased risk of vehicle accidents. During the summer, about 54 trucks per day will be delivering backfill materials when backfill operations take place.* However, there are no major industrial, commercial, recreational, or residential areas along the roads likely to bear most of the construction traffic associated with the proposed action. Furthermore, major residential areas will be avoided when transporting backfill materials to the site.

*Assuming that backfill operations occur for 3 years: 4 months each summer, 20 working days each month, and 10 yd^3 per truck.

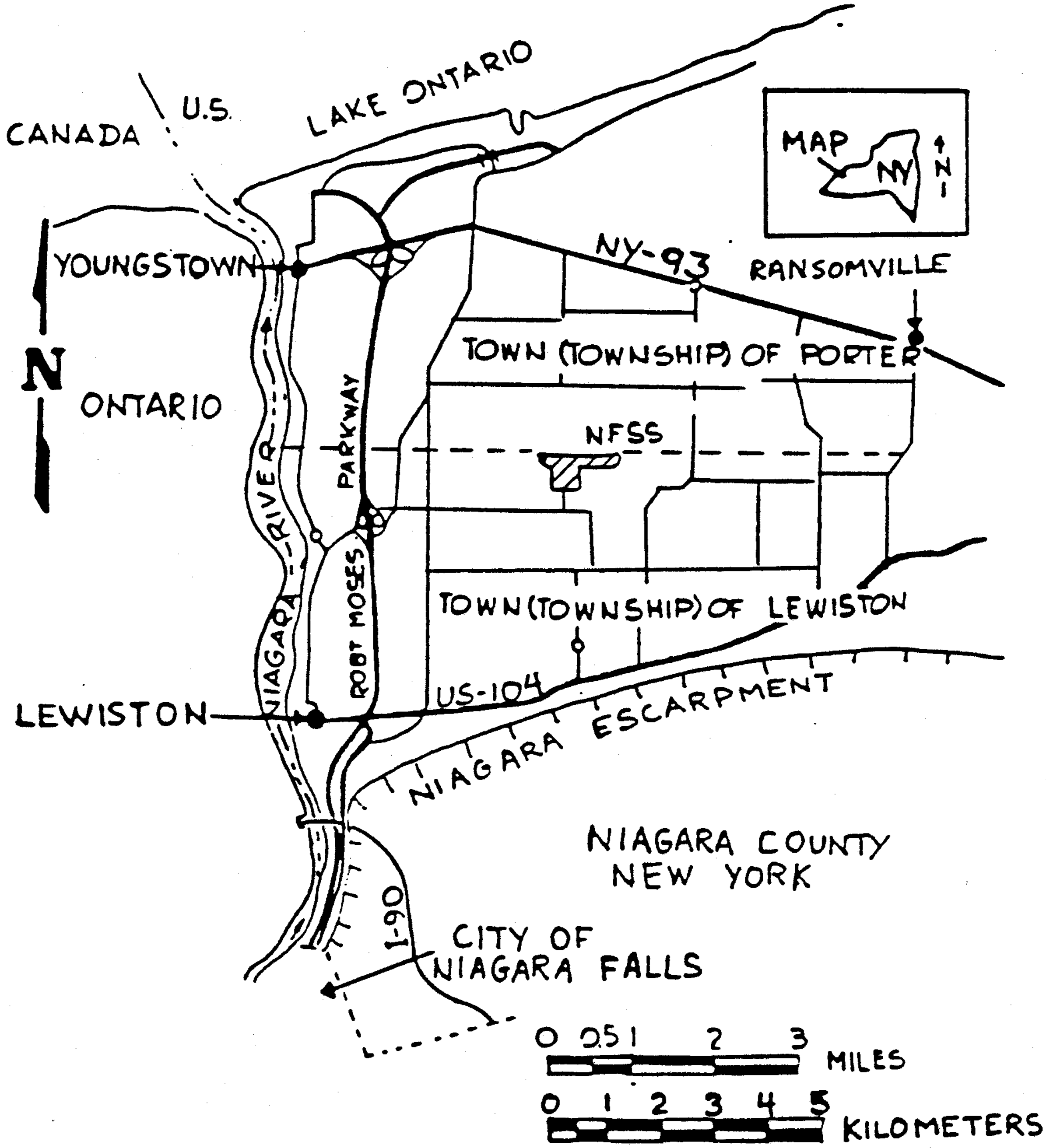

Figure 1. Niagara Falls Storage Site Location Map.

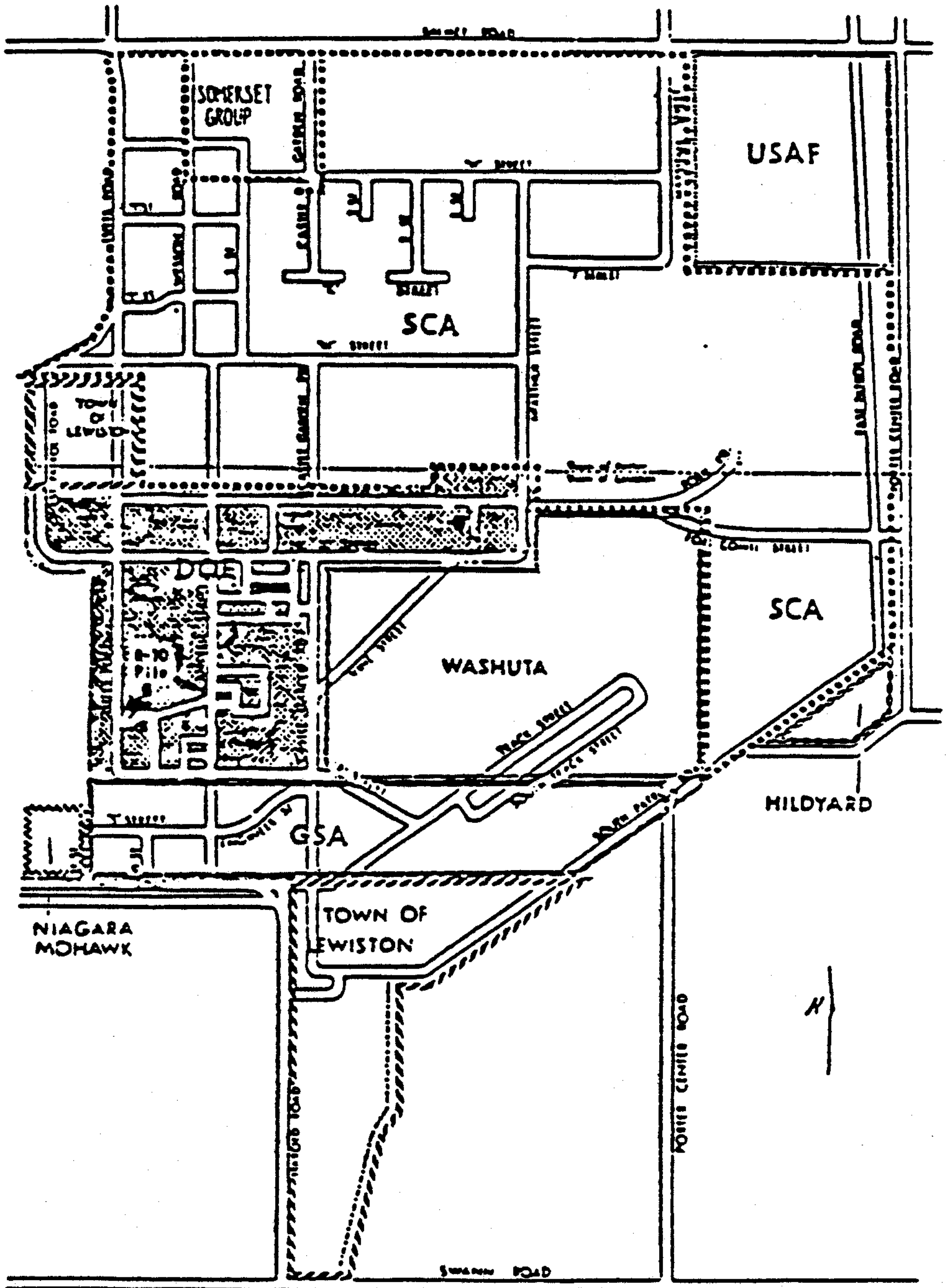

Figure 2. Current Ownership of the Original Manhattan Engineer District Site at the Lake Ontario Ordnance Works.

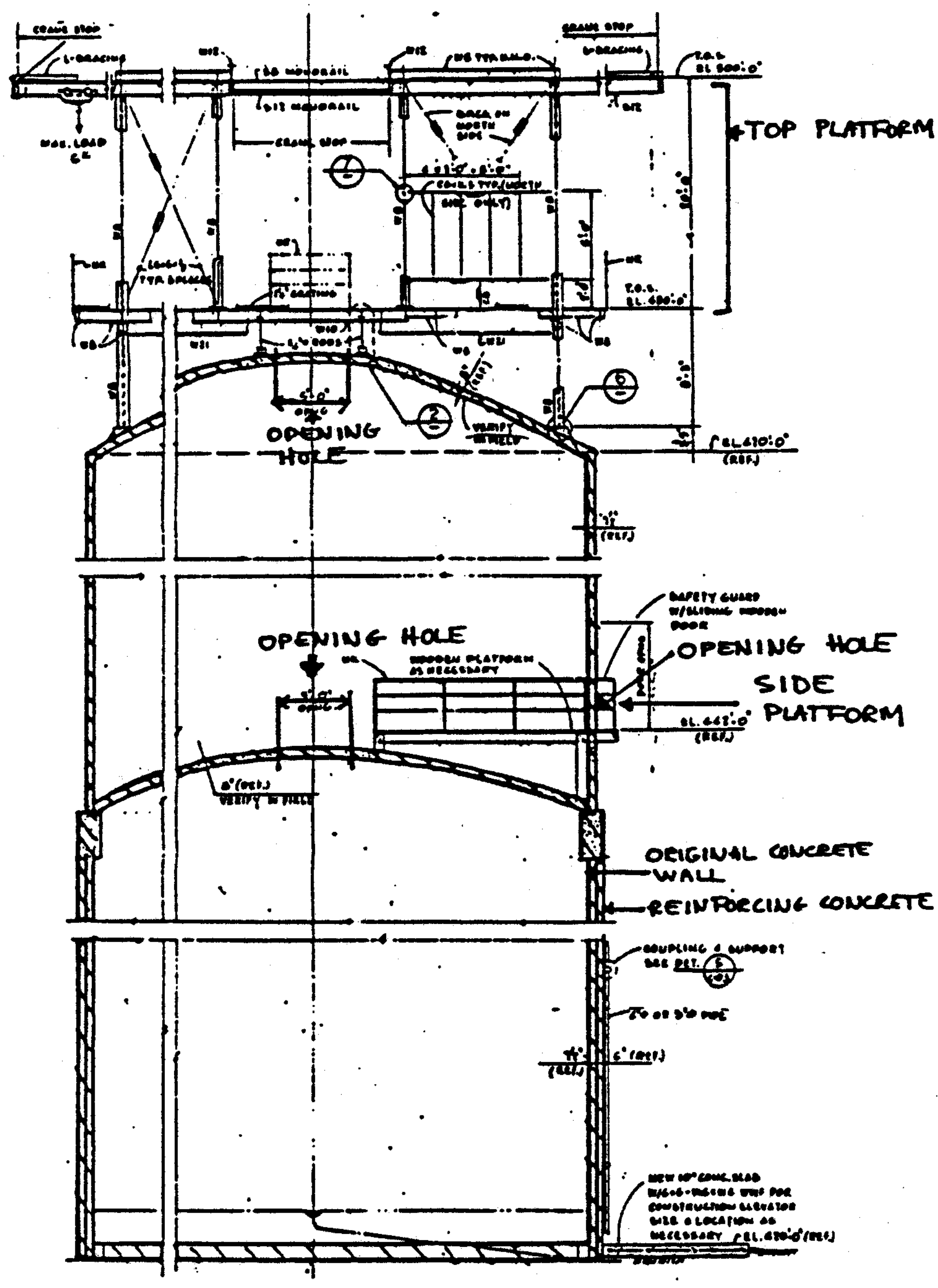

Figure 4. Building 434 ("K-65 Tower") Setup for Slurry Transfer of K-65 Residues. Use of a side platform is based on Preliminary design. Use of a large crane instead of platform construction is also being considered. Adapted from Bechtel National, Inc. (1983--Drawing No. 202-DD22-C-02, Revision A. Hydraulic Mining & Slurry Transfer Platform Plans, Sections & Details. February 25, 1983).

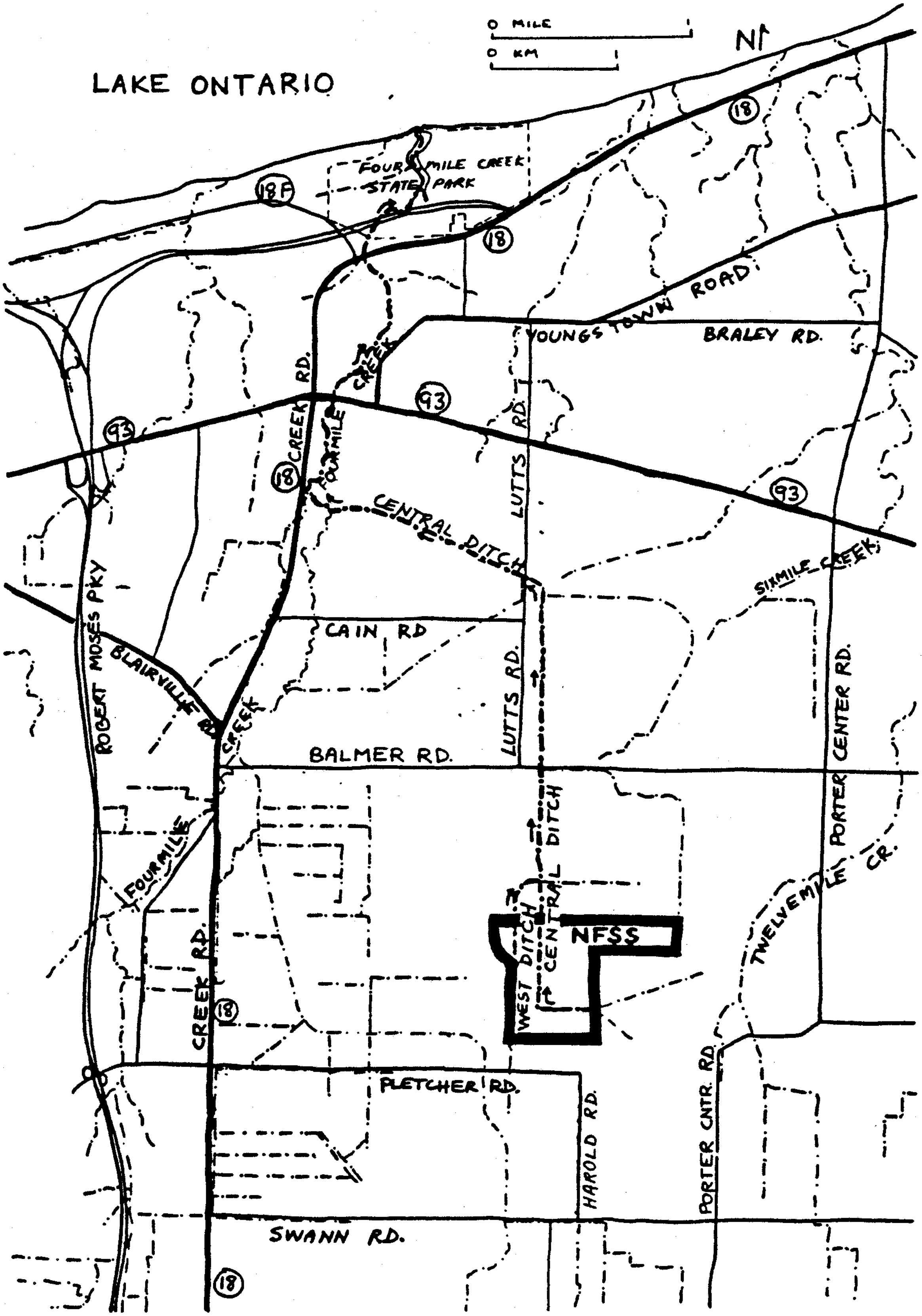

Figure 5. Drainage Ditches, Creeks, and Major Roads Near the Niagara Falls Storage Site. Adapted from U.S. Geological Survey (1965).

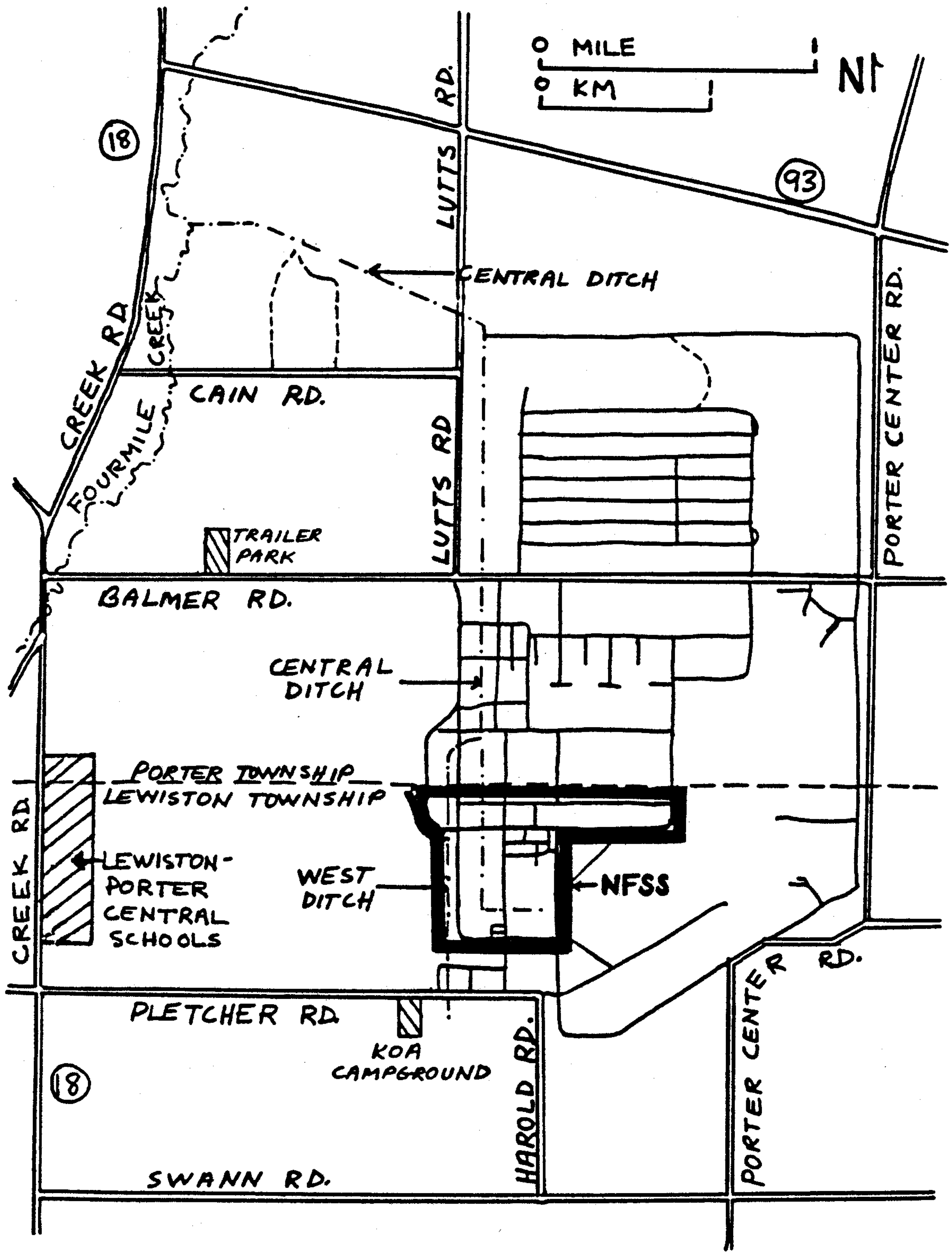

Figure 6. Primary, Secondary and Tertiary Roads (Public and Private) Near the Niagara Falls Storage Site (NFSS) and Central Drainage Ditch. Adapted from U.S. Geological Survey (1965) and 1980 aerial photographs.

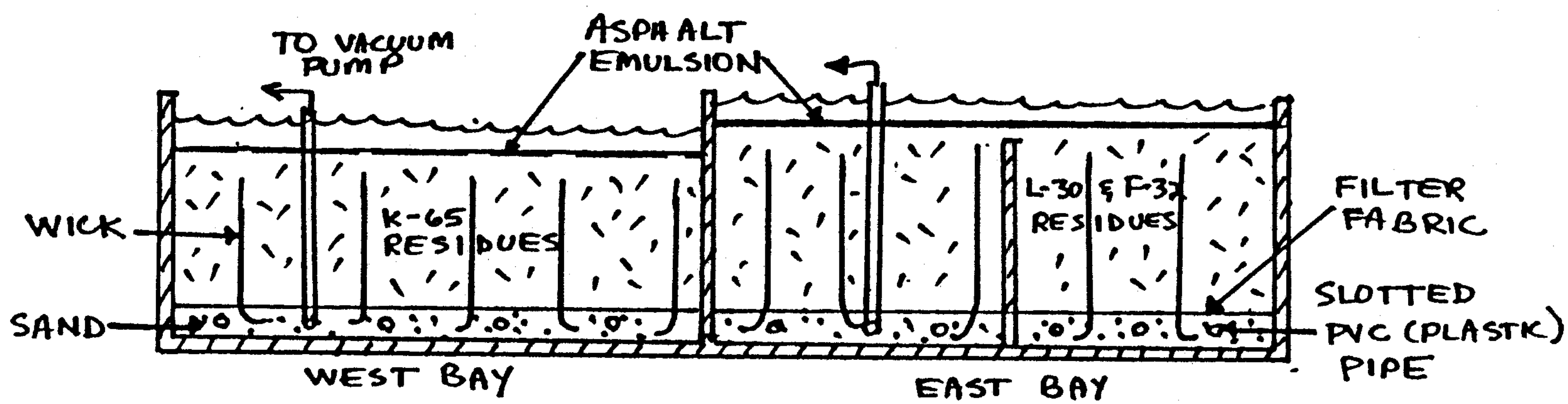

Figure 7. Residue Dewatering System in Building 411. Based on preliminary drawing provided by Bechtel National, Inc.

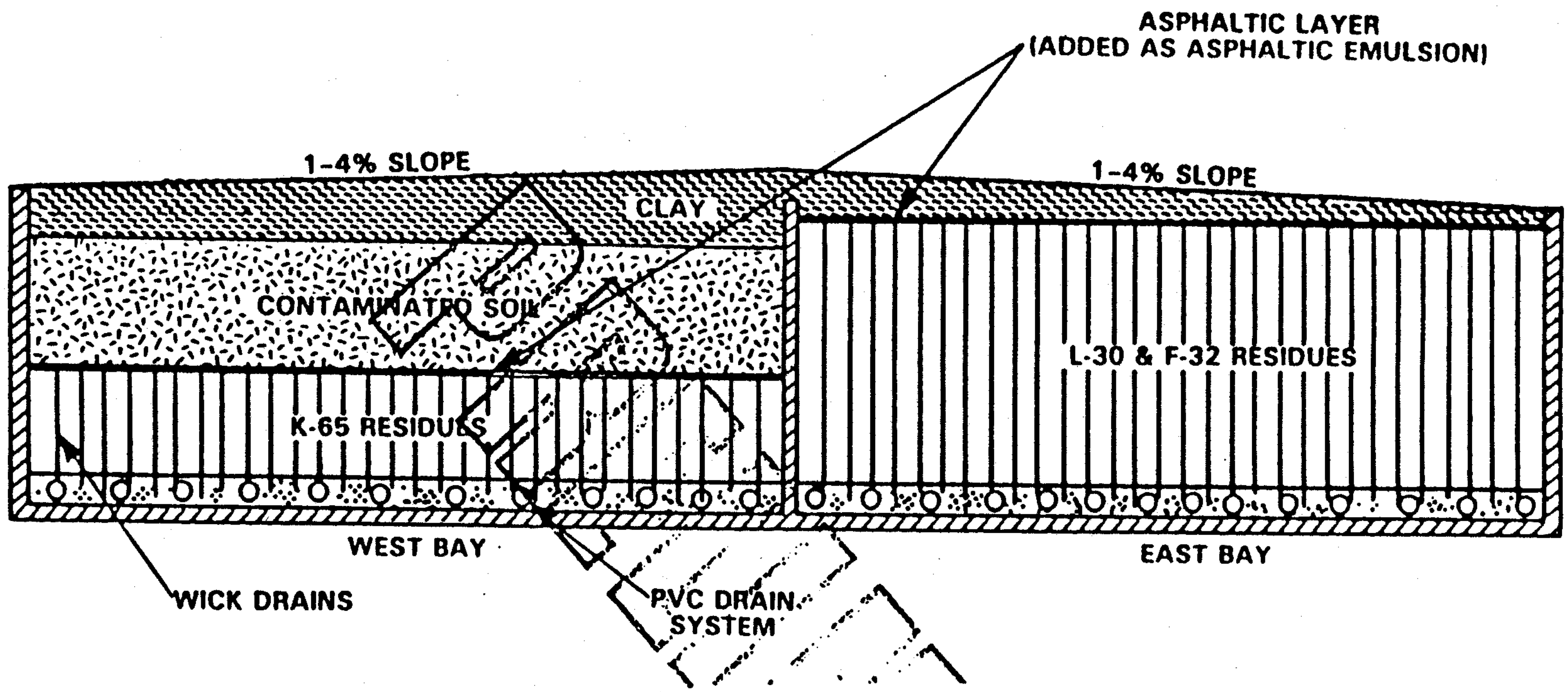

Figure 8. Cross-Section of Building 411 at the Completion of Residue Transfer and Dewatering Activities (Prior to Construction of Cap over Entire Diked Area). Based on preliminary drawing provided by Bechtel National, Inc.

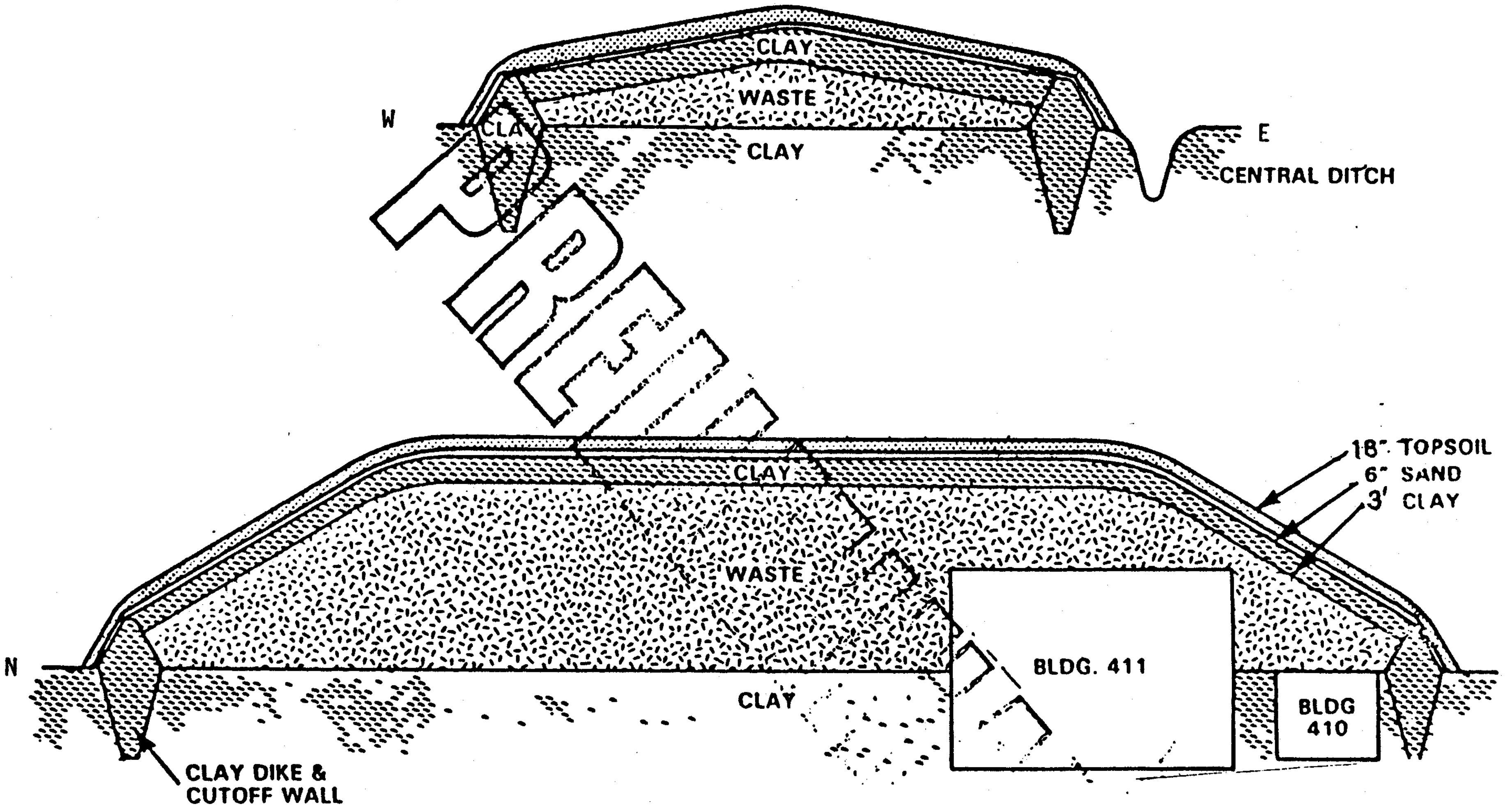

Figure 10. East-West and North-South Cross-Sections of Waste Containment Area Upon Completion of Interim Remedial Actions. Based on preliminary drawing provided by Bechtel National, Inc.

Table 1. Preliminary Estimate of Volumes of Contaminated Materials Stored at NFSS As of Completion of Accelerated Interim Actions in 1985*

Residues			Additional Contaminated Soils, etc.		
	Volume†[1]			Volume†[1]	
Description	m^3	yd^3	Description	m^3	yd^3
Afrimet					
K-65	3,000	4,000	R-10 area 1972 (above ground)†[2]	11,500	15,000
L-30	6,000	8,000			
F-32	500	500	R-10 area 1980 (below ground)†[3]	27,000	35,000
L-50	1,500	2,000	N diked area 1982, additional†[4]	12,000	15,500
Subtotal	11,000	14,500			
U.S. Government			N diked area 1983-84 additional†[5]	30,500	40,000
Middlesex sands	Negligible				
			Bldg. 411 cover†[5]	9,000	11,500
R-10	7,000	9,500			
Subtotal	7,000	9,500	N and S diked areas (remaining bottom)†[6]	10,000	13,000
			S diked area buildings and rubble	9,000	11,500
SUBTOTAL	18,000	24,000		108,000	141,500
20% Contingency	NA	NA		21,500	28,500
TOTAL	18,000	24,000		129,500	170,000

GRAND TOTAL = 150,000 m^3 (190,000 yd^3)

†[1] Rounded to nearest 500 m^3 or 500 yd^3. Grand totals rounded to two significant digits.

†[2] About 11,500 m^3 (15,000 yd^3) of contaminated soils were placed in the R-10 area during a 1972 remedial action. Analysis of the data for core samples taken in 1980 (Anderson et al. 1981) generally confirms this amount. Based on the Anderson data and an engineering drawing of the R-10 area prior to commencement of interim remedial actions in 1982 (Bechtel Natl. Inc. 1982c), there were about 18,500 m^3 (24,000 yd^3) of contaminated soils and residues (with radium-226 concentrations greater than 15 pCi/g) above the original grade in the R-10 area (covering about 4 acres). Subtracting the 7,000 m^3 (9,500 yd^3) of R-10 residues, there were about 11,000 m^3 (14,500 yd^3) of contaminated soils aboveground.

†[3] Based on the core samples taken in 1980 (Anderson et al. 1981) and the above-mentioned drawing (Bechtel Natl., Inc. 1982c), there was an estimated 27,000 m^3 (35,000 yd^3) of contaminated soils (greater than 15 pCi/g radium-226) below the original grade. It was conservatively assumed that the 15 pCi/g contaminated contour approached the shape of an upside-down wedding cake. The greatest depth of contamination was 3.75 m (12.5 ft).

†[4] It is assumed that the portion with radium-226 concetrations between 5 and 15 pCi/g could not be practicably separated from the portion with concentrations greater than 15 pCi/g.

†[5] Of the estimated 51,500 yd^3 of contaminated materials to be cleaned up both onsite and offsite during the 1983-1984 interim remedial actions, about 40,000 yd^3 would be placed in the north dike area and 11,500 yd^3 would be placed over the dewatered K-65 residues in Building 411.

†[6] 8.5 acres minus 4 acres (1980 R-10 pile area) minus 0.5 acre (dikes) = 4 acres. 4 acres × 2-feet deep = 13,000 yd^3.

*NOTE: Subject to revision based on ongoing engineering analyses.

Table 2. Radium-226 Inventory in Contaminated Materials Stored at NFSS as of Completion of Accelerated Interim Remedial Actions in 1985*

Description	Volume†[1] m³	Volume†[1] yd³	Average Ra-226 Conc. (pCi/g)	Ra-226 Inventory (Ci)
K-65 residues	3,000	4,000	220,000†[2]	775†[3]
L-30 residues	6,000	8,000	12,000†[2]	90†[3]
F-32 residues	500	500	300†[2]	0.1†[3]
L-50 residues	1,500	2,000	3,300†[2]	6†[3]
SUBTOTAL	11,000	14,500	--	871
R-10 area 1980, incl. R-10 residues†[4]	45,500	59,500	95†[3]	9
Remaining contaminated soils, rubble, etc.†[5]	70,500	91,500	--†[6]	3.4
20% contingency on non-residue materials†[5]	21,500	28,500		
SUBTOTAL	137,000	179,500		12.4
GRAND TOTAL	150,000	190,000		883

	% of Total Volume	% of Total Ra-226 Inventory
K-65 residues	2.1	88
L-30 + F-32 residues	4.4	10
L-50	1.0	0.7
TOTAL	7.5	99

†[1] Rounded to nearest 500 m³ or 500 yd³. Grand totals rounded to two significant digits.

†[2] Geometric mean of data given in Anderson et al. (1981).

†[3] Estimated inventory based on volumes times estimated average concentrations.

†[4] See Table 1. Includes original R-10 residues plus additional soils above and below ground contaminated to > 15 pCi/g Ra-226.

†[5] See Table 1. Does not include: (1) portions of covers, dikes, etc. that would have to be treated as contaminated materials if a future decision were made to remove all contaminated materials, (2) contaminated materials from vicinity properties that are currently being surveyed to determine if radionuclides occur in sufficient concentrations to necessitate removal and placement of the contaminated materials within the diked areas at NFSS.

†[6] No data available. The 3.4 Ci is an assumed upper limit based primarily on the fact that most of the soil materials were contaminated as a result of erosion of the original R-10 residues.

*NOTE: Subject to revision based on ongoing analyses.

Table 3. Existing (1975) and Projected (2000) Land Uses for the Towns (Townships) of Lewiston and Porter and for Niagara County

Location	Status of Land Use	Percent of Land Area						
		Residential	Commercial/ Public/ Semipublic	Industrial	Forest/Brush/ Outdoor Recreation/ Vacant	Agriculture	Water/ Wetland	Transportation
Town of Lewiston (25,088 acres)	Existing	7.7	6.2	1.0	32.2	43.5	7.7	1.4
	Projected	8.0	6.5	1.0	32.2	43.2	7.7	1.4
Town of Porter (20,992 acres)	Existing	4.1	4.6	1.5	25.8	61.9	0.3	1.6
	Projected	4.2	4.8	1.5	25.9	61.6	0.4	1.6
Niagara County (341,670 acres)	Existing	6.4	2.1	1.7	19.9	65.3	3.5	0.9
	Projected	6.6	2.2	1.8	19.9	65.0	3.6	0.9

Data from Interstate Commerce Commission (1981).

Table 4. Population Trends for the Towns (Townships) of Lewiston and Porter and for Niagara County

Location	1970†[1]	1980†[1]	1970-1980 (% change)	Projected 2000†[2]	1980-2000 (% projected change)
Town of Lewiston	15,888	16,219	2.1	16,500	1.7
Village of Lewiston	3,292	3,326	1.0		
Town of Porter	7,429	7,251	-2.4	7,800	7.6
Village of Youngston	2,169	2,196	1.2		
Village of Ransomville	1,034	1,101	6.5		
Niagara County	235,720	227,101	-3.7	235,500	3.7

†[1] Data from U.S. Census Bureau, New York Regional Office.

†[2] Year 2000 projections were based on 1980 projections that were 1 to 7% higher than actually occurred. Therefore, year 2000 projections may be too high.

Data from Interstate Commerce Commission (1981).

Table 5. Governmental Agencies with Potential Regulatory Control Over the Proposed Accelerated Interim Remedial Actions

Federal	
	Nuclear Regulatory Commission
	Environmental Protection Agency
	Department of Energy
State of New York	
	Department of Environmental Conservation
	Department of Health
	Department of Labor
	Department of Transportation
Niagara County	
	Finance, Public Health, and Public Safety Committee
	Health Department
	Board of Health
	Environmental Management Council
	Planning Board
Town of Lewiston	
	Town Board
	Building and Zoning Inspector
	Zoning Board of Appeals
	Environmental Conservation Committee

Data from Politech Corporation (1980).

Table 6. Clean Fill Requirements for Accelerated Interim Remedial Action Program at NFSS

Description		Volume m^3	Volume yd^3
South cutoff wall		14,500	19,000
South dike		2,300	3,000
Backfill in cleanup areas†[1]		5,500	7,200
Backfill in south diked area†[2]		21,000	27,000
Clay for Bldgs. 413 & 414 cap		800	1,000
Clay for Bldg. 411 cap†[3]		2,000	3,000
Interim cap:	Clay	31,400	41,100
	Sand	5,600	7,300
	Soil	17,600	23,000
		100,000†[4]	130,000†[4]

†[1] The amount of backfill in cleanup areas may be increased, depending on the amount of additional excavation that may be required as a result of additional radiological surveys and a change in the cleanup criteria.

†[2] Ongoing radiological surveys may indicate the need for excavation of some vicinity properties near NFSS. Contaminated materials from these properties would be placed in the south diked area, thus reducing the need for clean backfill materials. Cleanup of these properties is not part of the currently proposed action.

†[3] The amount of "clean" clay for the Bldg. 411 cap may be decreased, depending on the amount of additional contaminated clay soil materials that will be excavated and used as part of the cap.

†[4] Rounded to two significant digits.

Table 7. Mitigative Measures and Monitoring That Will Be Part of the Proposed Action

- Use of asphalt layer on top of L-30 and K-65 residues during dewatering operations; periodic inspection of the asphalt layer for excessive cracks; placement of soils and/or clay over the residues as soon as possible.
- Use of welded steel pipeline for the K-65 residue transfer; holding pond lined with EPDM; construction of an earthen berm around the tower to contain any leaks or spills; establishment of a spill prevention control and countermeasures plan.
- Controls over further spread of contamination--including establishment of contamination control zones, use of temporary plastic sheeting, decontamination of vehicles and equipment, erosion and runoff control measures, and worker monitoring.
- Prompt seeding and mulching of interim cap to minimize erosion.
- Standard contamination and worker radiation-exposure controls; education and training of workers with regard to radiation risks and health-physics procedures; use of protective clothing and breathing apparatus for work near the K-65 and L-30 residues.
- Air and water quality monitoring for radioactive substances; monitoring of the water for radiological and nonradiological substances prior to discharge; treatment of water (as necessary) to reduce concentrations of radionuclides to DOE operating limits and concentrations of nonradiological substances to state discharge limits.
- Routing of truck traffic to avoid residential areas, where possible.
- Informing local authorities, nearby property owners, and concerned citizens of the proposed action; designating a public liaison person; courteous treatment of site visitors; assurance to interested persons that the public will be involved in any decision-making concerning the long-term, permanent disposition of the site.

Table 8. Cumulative Radiation Doses to Selected Members of the General Public During Proposed Accelerated Interim Remedial Actions†[1]

Description of Person	Location of Person Relative to Building 411	Dose (mrem)			
		Whole Body	Bone	Average Lung	Bronchial Epithelium
Apartment resident at KOA campground (nearest permanent resident)	0.7 km SSW	0.02	0.11	0.12	10.6
Person at Lewiston-Porter Central Schools	2.4 km W	<0.01	0.01	0.01	0.77
Trailer park resident	2.6 km NW	<0.01	0.03	0.04	1.66
SCA Chemical Waste Services worker north of Bldg. 411	1.2 km NNE	0.02	0.17	0.2	11.4

†[1] Bases for radiological analysis are given in the text.

Table 9. Comparison of Doses to Nearest Permanent Resident from Remedial Action to Doses from Natural Background Sources

Dose from Remedial Action (values from Table 8)	Comparable Dose
0.02 mrem (whole body)†[1]	Equal dose of 0.02 mrem from riding 4 minutes in a jet plane at 10,000 m (33,000 ft) because of increase in cosmic radiation with altitude, or
	Equal dose of 0.02 mrem from staying for the same amount of time as the remedial action (19.5 months) at 2-m (7-ft) higher altitude
0.11 mrem (bone)†[1]	280 mrem received from natural sources (background) over the same period of time
0.12 mrem (average lung)†[1]	290 mrem received from background over the same period of time
10.6 mrem (bronchial epithelium)†[2]	520 to 980 mrem received from background over the same period of time

†[1] Conversion factors are given in reports of Argonne National Laboratory (1982) and National Council on Radiation Protection and Measurements (1975).

†[2] Based on 320 to 600 mrem/yr, assuming an outdoor radon-222 concentration of 0.3 pCi/L (Moses et al. 1963), an indoor concentration of 1 pCi/L (U.N. Sci. Comm. At. Radiat. 1977), and dose conversion factors for radon-222 of 1000 mrem/yr per pCi/L for outdoor background conditions (infinite source) and 625 mrem/yr per pCi/L for indoor conditions (50% equilibrium of radon daughters) (U.S. Nucl. Reg. Comm. 1980).

Table 10. Environmental Dose Commitments (EDC) to the U.S. Population†1 from Proposed Accelerated Interim Remedial Actions

Tissue or Organ	Person-rem or organ-rem†2		EDC as % Natural Background
	EDC	Natural Background	
Whole body	6	160,000	0.004
Bone	18	200,000	0.009
Average lung	17	210,000	0.008
Bronchial epithelium	1,200	600,000 - 1,200,000	0.1 - 0.2

†1 100-year EDC to the U.S. population within 80 km (50 mi) of the site.

†2 Values are for the period of 19.5 months required to complete the remedial action.

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